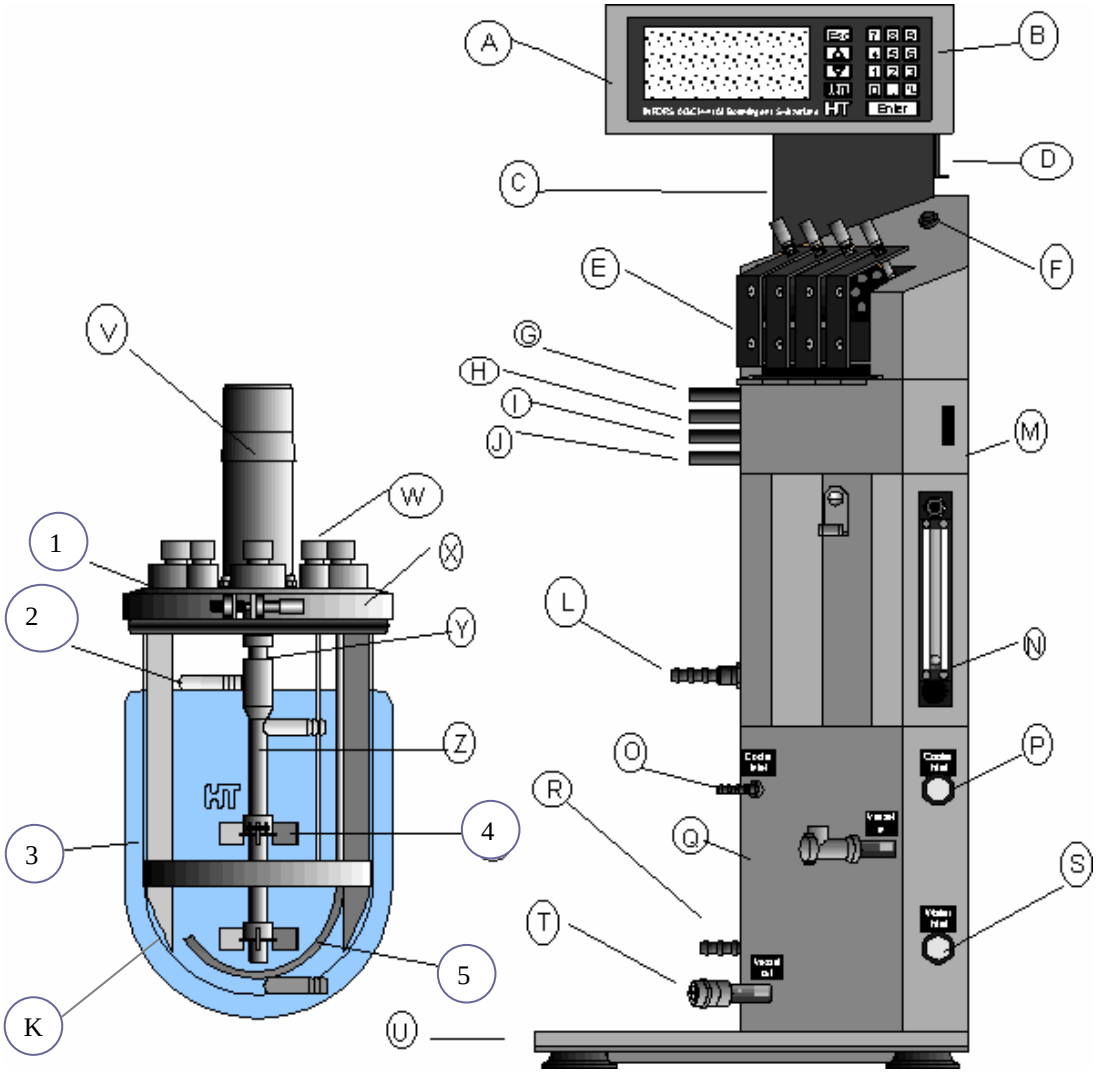
Labfors

Fermenters and Shakers
For over 30 years

INFORS AG ISO 9001

Service Manual



A= Display
B= Keypad
C= RS232 Port
D= Memory Card Slot
E= Peristaltic Pumps
F= Pump ON - Manual Button
G= Pt-100 Electrode Cable
H= pH Electrode Cable
I= Oxygen Electrode Cable
J= Antifoam Probe Cable
K= Baffles
L= Air Inlet
M= Operational Amplifier
N= Rotameter
O= Water Pipe for Gas Cooler
P= Water Valve for Gas Cooler
Q= Base unit - Heater Control
R= Water Inlet
S= Cooling Water Inlet Valve
T= Connector for Vessel Jacket
U= S. Steel Tray for Vessel
V= Drive Motor
W= Port Fittings
X= Top Plate Clamp
Y= Mechanical Seal
Z= Drive Shaft
1= Top Plate
2= Overflow Pipe to Drain
3= Vessel Jacket
4= Impellors
5= Sparger

F:\QS\Verk\Handbuch\Ser-hb\LabSer-e.doc

LABFORS SERVICE MANUAL Version 1.0

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SPECIFIC INFORMATION AS INDIVIDUAL SHEETS

8.1 PID drawings *(BigOver1.doc)*
8.2 Electrical schematics *(Elecsch.pdf)*
8.3 Pump head/ flow rate details *(Flowrate.doc)*
8.4 Calibration graphs for rotameters *(Calibgraph.doc)*
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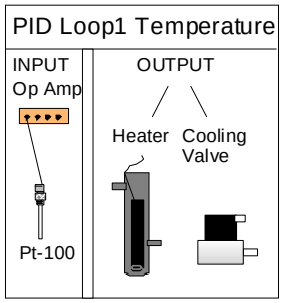
1. Dimensions, Technical Data and Services Requirements

Working volume :	**Approx. 0.5 to 10L**
No. of vessels :	**Up to three base units per Master**
No. parameters :	**^{o}C, rpm, pH (measure & PID control) pO_2 (measure & PID control + options), antifoam, substrate (cycle/dose control). Optional mass flow control and gas mix.**
No. reagent pumps:	**4 per base unit**
Temperature Control:	**Water temperature control via a Double-jacketed vessel OR Heater pad temperature control with a single- walled vessel.**
Temperature Range:	**5^{o}C under coolant temp. to 60/70^{o}C**
Heating	**500W per station**
Stirrer	**Electronic, brushless DC motor with tacho-feedback ,PWM controlled Top drive with direct coupling via a single mechanical seal, impellors & baffles or a draft-tube system OR Axial magnetic drive system**
Speed range(s):	**approx. 20-1200 rpm**
Data connection	**RS232 (Tx, Rx and ground only)**
Profile storage	**Memory card (type PCMCIA)**
pH range:	**2-12pH**
pO_2 range:	**0-100%**
Antifoam:	**Total cycle time and dose time-40% max**
Feed Pump:	**Total cycle time and dose time-40% max Optional conductivity probe**
Dimensions (Length x Depth x Height)	**410 x 375 x 930 mm (Master + Base) 375 x 375 x 735 mm (Base only)**
Services	**Electricity 230V, 50Hz 6A ("noise-free") Water > 1.5 bar Air ~1.5 bar***

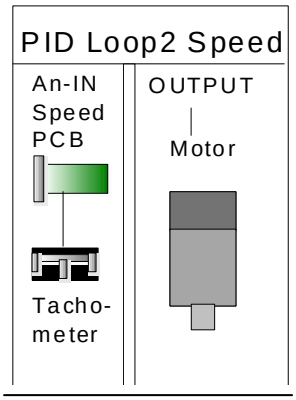
Overview of the Labfors Systems of Measurement & Control

TEMPERATURE



Temperature is controlled using an electrical heating jacket or water thermocirculator. The thermocircualtor sends liquid around the vessel jacket and heats it with an electrical element if required.
Cooling water enters via a magnetic valve and leaves via an overflow pipe. Water goes either directly into the vessel jacket or into a cold finger, depending on the heating type.
The range of control is approximately 5ºC above the cooling temperature to 60ºC. A signal from a Pt-100 temperature sensor in the culture is used for feedback control by the micro-processor to activate either the heater or the cooling valve. A closed circulation of chilled water can be accommodated if required. The main controller display shows actual value , setpoint PID control etc.

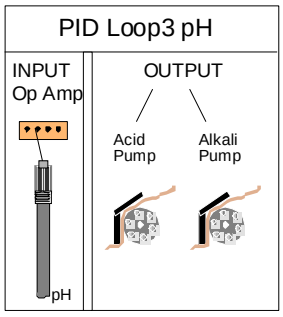
STIRRER SPEED



A setpoint is given to the control circuitry by the microprocessor. A tachometer in the motor provides the signal for feedback control. The PID control values are factory set for this parameter. The main display shows the actual value for speed. The level of dissolved oxygen can be cascaded to influence the stirrer speed. Speed range is typically 20-800 or 40-1200 rpm.

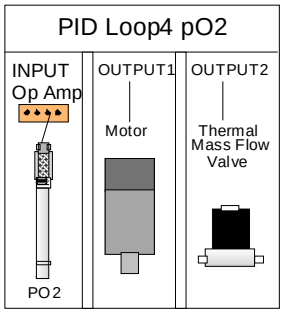
Adjustments can be made using potentiometers and dip switches on the speed controller pcb in the second section of the base unit.

pH



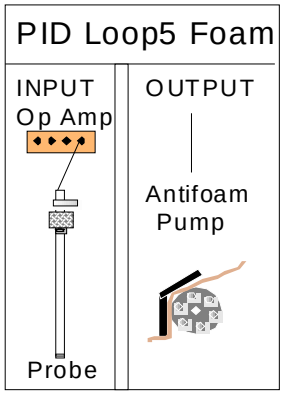
The pH measurement and control system consists of an electrode linked to a signal conditioning module which sends the measured value to the microprocessor. Calibration is digital and similar to the procedure for a bench meter. Range is typically pH 2-12.
Integrated peristaltic pumps deliver a timed dose of either acid or alkali reagent into the fermenter vessel. The total “on” time of each pump is recorded and can be used to measure how much reagent has been added.
Temperature compensation can be activated if required.
A gas valve for CO_2 may replace the acid pump.

DISSOLVED OXYGEN



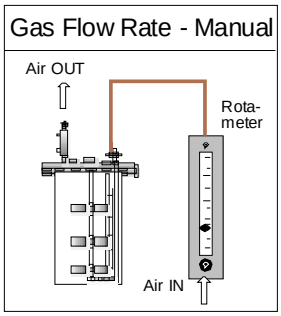
Measurement of dissolved oxygen is via an electrode linked to an integrated operational amplifier within the signal conditioning module. A polarising voltage is also supplied by this unit. Calibration is similar to a bench meter with zero and 100% values being set.
Control is by a PID loop acting on either the stirrer speed or by influencing an optional thermal mass flow control valve to adjust the air flow rate.
A gas-mixing unit can be used for special applications such as animal cell culture. Range 0-100%

ANTIFOAM (optional)



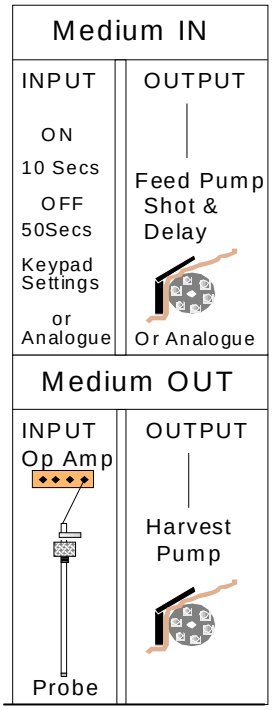
Control of foam is based on a conductivity probe above the culture surface detecting the build-up of foam by contact with the probe tip. The rest of the probe is insulated to prevent false signals.
After a user-selectable waiting time (delay) the integral peristaltic pump delivers a dose of antifoam reagent (shot).
The system then resets and will only add more reagent if foam is still present.
This arrangement can double as a level control system to remove culture.

GAS FLOW



Unless specified otherwise, control of gas flow into the fermenter is usually set manually. A separate pump or laboratory air supply is connected to the fermenter supply pipework which has an integral pressure regulator valve.
The flow rate is adjusted using a rotameter calibrated in litres per minute/hour.
The maximum air flow rate should be no more than 1.5 vessel volumes per minute.
A mass flow valve and/or gas mixing system may also be used.

CHEMOSTAT OR CONTINUOUS OPERATION (optional)



This relies on a balance being set between addition of fresh medium into the vessel and removal of culture. The correct rate matches the growth of the microbes so that a constant concentration in the vessel is maintained.
If the growth of the organism is limited by eg. a source of sugar in the medium then the fermenter is being operated as a chemostat.

Medium is added to the culture by a peristaltic pump which can be an integrated digital unit relying on shot and delay times or an external analogue pump with variable speed.

Harvest of culture can be achieved by using a level control system (antifoam pump used in reverse to withdraw culture), or a simple side-arm acting as an overflow (option).

Even if the fermenter is operated as a chemostat for a short time, large containers are needed for both fresh medium and harvest.

Antifoam reagent can be added to the fresh medium at a low concentration (eg. 1:20,000) if required)

2. Setup and Basic Operation

Transport

n view of the weight of the complete LABFORS and packing materials it should never be carried by one person alone. For moving the packed system over long distances, a low trolley or palette raiser is recommended.

If the LABFORS is to be transported by a fork lift truck, **it is vital it is secured in such a way that there is no chance of it falling off or otherwise being damaged!**

Packing and disposal

The LABFORS is shipped in a wooden crate. All packing materials are environmentally friendly and can be re-cycled.

Unpacking and Checking.

Please make sure that no part of the LABFORS sustains damage during unpacking. Use the delivery documentation to ensure that all parts are present. If there is a discrepancy between the list and the contents and/or there are any signs of transport damage, please contact Infors **at once**.

If this advice is not followed promptly, any resulting costs will be the responsibility of the purchaser.

All accessories and flexible connection pipes are usually packed in a cardboard box placed on top of the fermenter base unit. The vessel is also packed in a separate cardboard box within the crate.

Location

The LABFORS fermenter is best mounted on a laboratory bench of suitable working height.
Access to air, water and power services should be nearby along with a suitable drain / sink.
A free space of 50cm should be left all around the fermenter to make servicing both easier and quicker.
The unit should be sited away from potential sources of electrical noise.

Services

The final connection of the fermenter to the services will be made by INFORS if installation is requested by the customer.
This is aided greatly when all services outlets include the necessary pressure reduction system already installed by the customer.

Services Connections

Power

230V/10 A single-phase supply for standard LABFORS

The power supply should be clean and constant - if not, it is recommend fitting of suitable filters and or a UPS to the mains power supply.
In addition to the plug fuse, 2 fuses can be found behind a cover above the location of the connecting socket in the mains inlet and On/Off switch.

Air

The air inlet can be found on the left side of the fermenter. Use only clean, dry oil and dust free air with a pressure of >= 2,0 bar.
A push-on Connector pipe is used with braided tubing. Fit a "jubilee clip" at each end of the pipe to secure it.
Inlet air is supplied through the rotameter (variable area flow meter) to the vessel. Ensure this is turned on using the black knob below the rotameter scale.
Calibration graphs are provided in the operating manual.

Water Inlet

Cold (& preferably soft, <50ppm suspended solids) water supplied at a pressure of >= 1,5 bar enters from the left side of the base unit of the fermenter.
Push-on connector pipes are supplied separately in a bag. Push one of these into place and fit braided tubing to the cold water tap. Use "jubilee clips" to secure pipe to fitting at **both** ends.

Water Drain

The drain outlet is on the top of the fermenter jacket - if applicable. It requires a clear fall to the drain / sink without sharp bends or kinks.
Push fit onto glass connection arm at the top of the vessel jacket - CARE! (not applicable to systems which use an electrical heater pad).

Exit Air

The exit air leaves via the disposable filter attached to the exit gas cooler (if fitted).
If oxygen supplementation is used, take care to pipe the exit air away safely to avoid explosion risk.

Vessel connections:

Temperature control

Connect either the water circulation pipes to the vessel jacket using the rapid coupling connectors or plug in the heater had and secure to the vessel using the velcro tabs.

Inlet of water into the jacket is controlled by a manual valve on the right /front side of the bottom section of the base unit. Open this valve fully for first operation after connection of the vessel.

Connect the inlet pipe of the exit gas cooler using the small rapid coupling connector and connect braided tubing to the outlet (top pipe) and place the free end in the drain/sink.

A second manual valve on the right/front side of the fermenter controls water inlet into the exit gas cooler. This is turned on to give a steady flow through the exit gas cooler.

The vessel top plate is equipped with a Pt-100 temperature probe. This is in a 10mm clamped port and a 2-pin Lemo connector. It is used for connecting to orange cable from the operational amplifier module. Push to fit when the red spots on cable and connector are aligned.

Gas supply

Fit a 0.22u filer to the top of the vessel sparger using braided tubing (long enough to allow a clamp to be placed between the filter and the metal sparger pipe).

Connect the air line from the rotameter to the air sparger in the vessel by braided tubing, pushing it onto the air filter.

If a gas mixing system is present, connect the gas supply bottles to the appropriate inlets either to the rear of the base unit or on the separate gas mixing box.

Initial Setup Checklist

1. Memory card in place
2. Water line connected
3. Drain line connected
4. Air line connected
5. Vessel connected to heating system
6. Rotameter outlet connected to sparger
7. Exit gas cooler inlet & drain connected
8. PT100 temperature sensor connected
9. Drive motor connected
10. Air supply turned on
11. Water supply turned on
12. Mains power on

This is purely for testing the basic functions of the fermenter. Connecting of probes etc. is covered in a separate section.

Drive System

The drive motor is permanently connected to the right hand side of the base unit. It is placed on top of the vessel and locks into place using a lug on the vessel drive hub and a "key-way" on the connecting hub of the drive motor. To fit, place the motor on the vessel drive hub (having first removed the plastic protection cap) and turn until the motor falls into place with only light guidance.

Before first use, the vessel drive hub needs lubrication if this is not already present as part of the factory testing of the vessel.

NEVER run the drive system dry, it will ruin the mechanical seal in a very short time.

Lubrication of the top seal

The base of the drive hub has two short pipes sticking up where it joins the vessel top plate. They are joined by a short length of silicone tubing.

If liquid cannot be seen in this silicone tube, the seal need re-filling.

To do this, undo the silicone tubing at the longer pipe and connect a syringe containing a few millilitres of glycerine. Inject the glycerine gently until liquid comes out of the top of the longer steel pipe. At this point, the seal system is filled and the tubing can be replaced. Autoclaving sterilizes the glycerine

This needs only to be done occasionally but should be checked every time the vessel is to be used.

Connection to a computer/Printer.

The Labfors has an RS232 serial port on the left side of the black support for the screen/keypad. If specified, a cable should be provided which connects to this port and a 9-pin serial port at the rear of the computer. Installation and use of IRIS software is the subject of another guide.

Printers must have a serial port or a parallel/serial converter in order to link directly to the Labfors.

Additional cables and equipment.

It may be that some extra cables are included in the packing. These are likely to be for external analogue pumps, satellite base units or special cables for connecting peripheral items eg. turbidity meter, methanol sensor etc.

Specific instructions for connecting these items should be available. If in any doubt, contact Infors.

Reagent bottles are normally provided with the system. These are set up separately and for test purposes can be filled with water. See diagram for correct set-up.

Bringing into use (from a service viewpoint)

1. Check all O ring seals for wear and replace as necessary. Smear with a ***little*** high temp. grease.

2. Undo the clamping ring using the screw at the front of the vessel. The top plate can be lifted clear of the vessel glass, which remains in place.

3. Check the large "O" ring seal in the grooved flange of the vessel glass is lightly greased, not damaged and not wrinkled when in place.

4. Charge vessel with water to approximately the required working volume of the vessel.

5. Replace the top plate and tighten retaining clamp to finger tight. Take care not to accidentally clamp the autoclaving cover for the Pt-100 in the clamp. Tighten all three screws on the clamping ring for even pressure on the seal

6. Equip any unused ports with a membrane, collar and port closure if the port is to be used for additions post-autoclaving. If not, a blanking port closure is sufficient.

7. Calibrate the pH electrode using the appropriate menu option in U-DDC and buffers of eg. pH 4 and 7. Follow the instructions to set a low and high reading.

8. The dissolved oxygen electrode low-value calibration can be set using the zeroing gel provided ***CARE-*** strongly alkaline solution.

9. Fit the pH and dissolved oxygen electrodes in the 13.5PG ports (they have a finer thread than standard), using adaptors if the electrodes are too long to fit without.

The other vessel fittings can be added such as sample pipe, exit gas cooler and acid/alkali inlets.

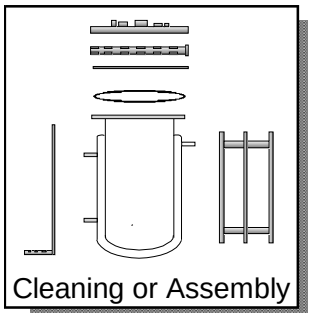
OPERATION

1. Air flow should be set to no more than 1.5 vessel volumes per minute eg. for a 1.2L working volume vessel the max. is 1.8NL/min.

2. Pass the tubing from the reagent bottles through the appropriate peristaltic pump, using the small connector in these lines to stop the tubing from being pulled through the pump. Unclamp the connection between the bottle and the vessel.

3. Calibrate the 100% dissolved oxygen high value by passing air through the vessel at maximum flow rate when the stirrer speed is also at the maximum to be used. At least 2-6 hours is needed before electrode is usable.

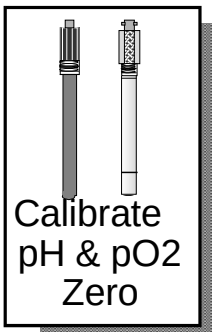
4. Complete the set-up by setting appropriate setpoint values. This should be sufficient for an installation check without autoclaving.

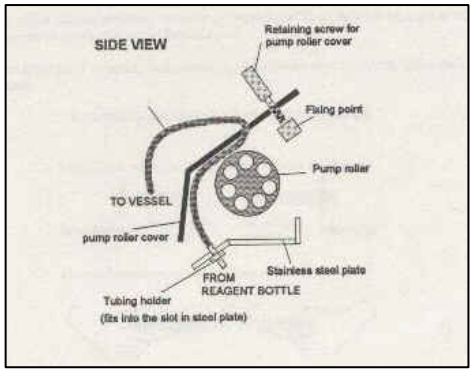


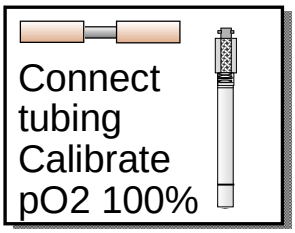
Check the electrode condition, then prepare the electrodes for first use according to the instructions given in the relevant appendix. i.e.

pH - remove white sealant over diaphragm completely.

pO2- unscrew base section, remove diaphragm cartridge and half fill with electrolyte. Replace.







- **UDDC Instrumentation (basic points)**
- The UDDC2 instrumentation is based on a powerful industrial process controller which uses a memory card (type PCMCIA) to store data about Set-points, profiles etc.

- The keypad is splashproof and has several sections, each with keys which perform specific tasks:

Numeric keys [1]..[9] plus [.] Data Entry	
numbers 1..6 .	Select fermenter
[+/-]	"Toggles" options
[Enter]	Confirmation
[Esc]	Abort last action
[UP ARROW]	Moves upwards
[DOWN ARROW]	Moves downwards
[Menu]	Go to Main Menu

- The screen is a high-contrast LCD unit displaying 40 characters by 16 lines. Different areas of the screen provide different sorts of information:

Top Line	Fermenter data
Second line	Current option
Lines 4-13	Fermenter values
Lines 15-16	HELP information

- A square flashing cursor [] appears in a number of screens against something which can be changed.

STARTING OR STOPPING A FERMENTER

1. To start a fermenter from the Main Menu select Option 1, fermenter Menu.
2. The screen changes to allow you to select which fermenter (1..6) to start using the numeric keypad.
3. The Fermenter Menu is then displayed. Select Option1, Start/Stop.
4. In the start/Stop screen use the [DOWN ARROW] key to move through the options, deciding which parameters to keep On and which to switch Off using the [+/-] key.
5. Finally, use the [+/-] key to switch Start Fermenter to On and press either [Enter] or [Menu] to confirm.
6. [Menu] takes you back to Main Menu and pressing[Esc] will let you see the Values screen.
7. To stop an active fermenter, select Option 1, Start/Stop from the Fermenter Options menu and use the [+/-] key to toggle Stop fermenter to On & press Enter] or [Menu] to confirm the shutdown.

CHANGING A SETPOINT

1. There are two ways to change a setpoint:
2. From the Values Screen - simply press [Enter] after first selecting the parameter with the cursor.
3. Alternatively, press [Menu] to show the Main Menu and press [1] to select the Fermenter Menu.
4. Press [2] for the Parameter Menu. The Parameter Selection sub-menu will allow you to choose the parameter you want to change eg.[1] RPM.
5. A new setpoint is entered using the numeric keys and confirmed with [Enter].
6. [DOWN ARROW] moves to the Alarm Lim. field where a symmetrical alarm limit value can be entered outside of which an alarm will be generated.
7. Press [Enter] to confirm the value **and [Enter] again** to return to the parameter menu.

```
Main Menue

1 Fermenter Menue          2 Parameter Menue
3 Printer/Comms            4 Hardware Options
5 Password                 6 Copy Memory Card
```

```
Fermenter Menu

Fermenter: F 1

1 Start/ Stop              2 Parameter Menu
3 Fermenter                4 Pump/ Flow  Settings
5 Edit Profile             6 Profile Control
7 Ferm. Overview           8 Pump Timings
9 Alarms                   0 pO2 Control def.
```

```
Fermenter:  >F1<     Status OK              00d00:00
[Start/Stop]
_____________________________________________________

 Fermenter:  F1

 PH Control    : Off          pO2 Control  : Off
Temp Control  : Off          RPM control : Off
Antifoam       : Off
          START FERMENTER; Off

_____________________________________________________
Menu for Main Menu
+/- to change value; Enter / Esc to exit
```

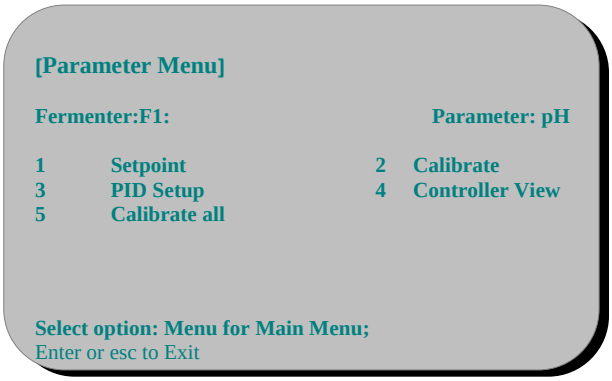
```
Fermenter >F 1>          Status  OK  00d 20:49

Long View

Name          Value          Setpoint    Output
RPM      I    1200      I    ■ 950.      .......

Temp     I    37.1      I    37.0        10
pH       I    7.2       I    7.0          60
pO2      I    78        I    80          13
AF       I    Off       I    .........   ......
Flow     I    0.45      II               .......

    Menü for Main Menue
    Enter to Edit Setup;  Esc for Value
```

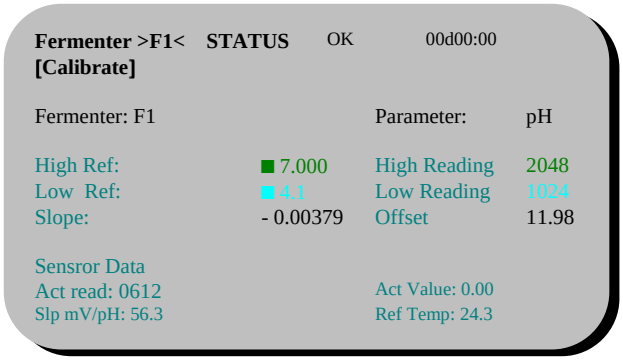
CALIBRATION

1. Calibration of parameters is possible for both active and closed down fermenters. The RPM parameter **cannot** be calibrated as this is factory set.

2. Press[Menu] to get to Main menu
3. [2] to select parameter menu
4. eg.[1] to select the fermenter (1..6)
5. eg.[2] to select the desired parameter
6. (1..5)
7. [2] to select the Calibrate screen

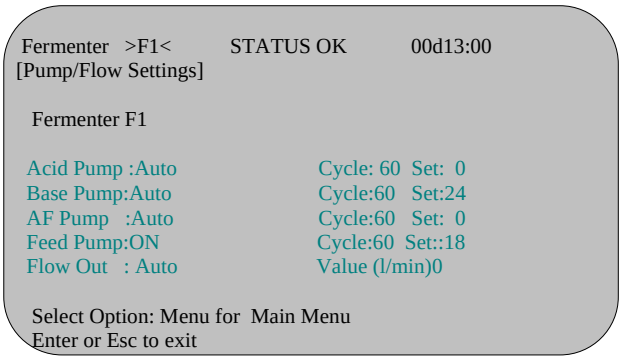
8. Enter the High Ref. values using the numeric keys eg. 60oC and press [Enter] to confirm.
9. Press [DOWN ARROW] to move on.
10. The High Read is a value generated by the A/D converter in the instrumentation - press [Enter] to allow the reading shown in the Act Read display to replace the current value in the High Read position.
11. Use the [DOWN ARROW] key to pass over the value.
12. Repeat the process for the Low Value and Low Reading.
13. Press ENTER to confirm or Menu.





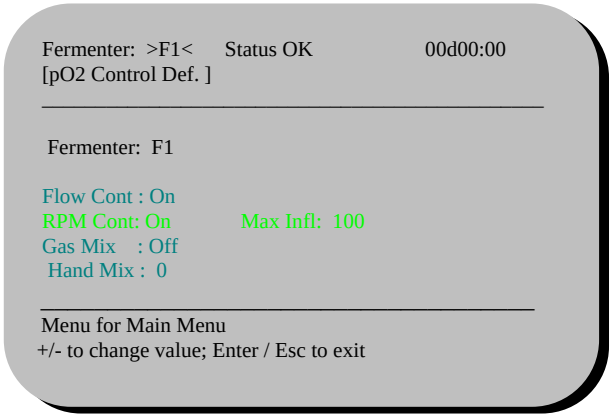
PUMP/FLOW CONTROL

1. This screen allows the built-in reagent and feed pumps to be set to ON. OFF or AUTO control.
2. Acid, Base and Feed pumps can be ON. OFF or AUTO eg. when the acid and base pumps are under the control of the pH control system.
3. The feed pump can only be set to ON or OFF.
4. The cycle and set values are in seconds and allow different flow rates to be achieved by varying the time a pump is active over time. The maximum duty cycle for any pump is 40% of the total cycle time eg. cycle=60, set=24 secs.
5. This screen is reached via the Fermenter Options Menu.
6. Use the [+/-] key to toggle On, Off or Auto options [DOWN ARROW] moves on to the next position.
7. Enter the cycle time in seconds and use [Enter] to confirm the new value. [DOWN ARROW] moves you on. Repeat for the Set time.
8. The flow setting allows the thermal mass flow valve (if fitted) to be controlled with a manual value for gas flow rate in litres per minute. This valve is usually under the automatic control of the pO2 control system.
9. A final [Enter] or [Menu] confirms the new values. [Esc] aborts the process



DEF PO2

1. This screen allows several options to be set for control of dissolved oxygen. It is accessed from the the Fermenter Menu.
2. If Flow Control is set to On using the [+/-] key then oxygen control is via the optional thermal mass flow control valve.
3. If the RPM control is set to On, then speed is used to control pO2 - either in place of the flow valve or additional to it!
4. Max Influence sets a symmetrical limit in RPM in which control of pO2 can take place eg set point of 1000RPM with max. influence of 200 would give control of pO2 by stirrer speed from 1200 to 800 RPM only. **This is the only standard option!**
5. Gas Mix and hand Mix only apply to systems with a special gas Mix unit.


Fermenter: >F1< Status OK 00d00:00
[pO2 Control Def.]
Fermenter: F1
Flow Cont : On
RPM Cont: On
Max Infl: 100
Gas Mix : Off
Hand Mix : 0
Menu for Main Menu
+/- to change value; Enter / Esc to exit

3. Cleaning

Before disconnecting the corrective reagent feed lines from the peristaltic pumps they should be clamped off. They can then be emptied manually after re-sterilization.

Mains switch
On the right hand side of the base unit
OFF.

On safety grounds, the fermenter must be switched off and the drive motor removed before opening the vessel

Cleaning the base unit and Master-Control panel.

1. Use a soft, damp (NOT WET) cloth and a neutral detergent to wipe away any stains or grime.
2. Clean the unit down with electrical power off and allow to dry completely before use.
3. After a spillage, the stainless steel tray at the bottom of the base unit may be removed for emptying and/or cleaning in a sink.
4. Any spillages of reagents (especially acid or alkali) must be wiped up immediately - CARE NEEDED.

Cleaning of a recently-used system

Please note: sterilization of the vessel and peripherals MUST be done by the user prior to your starting work on the equipment!

1. The pH and dissolved oxygen electrodes should be removed and stored in suitable reagents according to the manufacturer's instructions which come with each electrode. Copies are included in the appendices of this operating manual.
2. Periodic cleaning and regeneration of the electrodes are also covered by these instructions.
3. The vessel should be rinsed several times in distilled water to remove any loose culture residues.
4. Growth of culture on the vessel walls may require disassembly and light brushing to completely clean the glass.
5. If the vessel must be tipped up to empty out any culture or cleaning liquid, ensure both the glass section AND the metal support frame are BOTH held firmly. This prevents the glass side arms of the vessel jacket being broken off by contact with the support frame.

Examination of the vessel during cleaning

During cleaning of the vessel, an examination for any chips or cracks in the vessel glass can be made and faulty vessel glasses MUST be replaced.

To disassemble the vessel glass from the support frame it is necessary to first loosen and then remove the bolts holding both the top and bottom collars of the support frame together.

Any O ring seals which appear flattened or dry should be replaced and the new seals lightly greased with a mineral compound such as eg. Edwards' high vacuum grease.

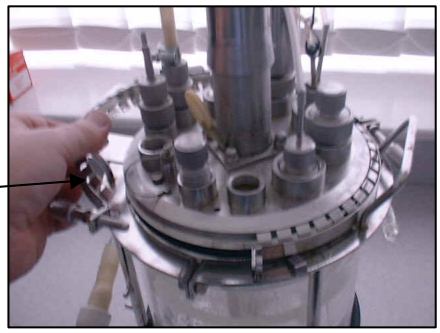
Membranes which have been pierced should be replaced.

4. Exchange of Consumable Parts

During a routine service inspection, a number of consumable parts may have to be exchanged.

4.1 Vessel seal

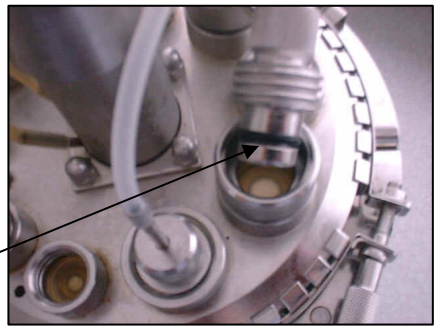
The vessel seal is critical for maintaining an uncontaminated environment for the culture.



1. Remove the clamping ring from the vessel to release the top plate.
2. Carefully lift the top plate upwards so the pipes etc. clear the lip of the glass section and place the top plate gently on its side away from the glass section. The glass section will continue to be supported by the metal frame surrounding it.

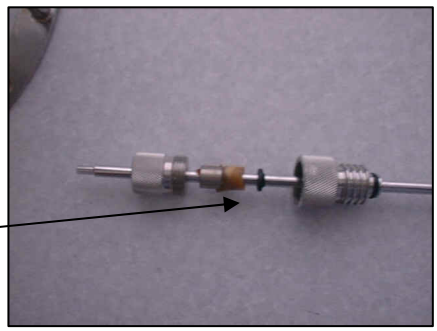
3. The vessel seal is a large "O" ring sitting in a groove in the flange at the top of the glass section. If it is flattened or shows signs of fraying then it should be replaced with a new one.
4. The new seal is very lightly greased with silicone grease and placed in the groove. It must fit snugly without any wrinkles. If a good fit cannot be achieved, discard the seal and use a new one.
5. Re-assemble the top plate onto the vessel glass and replace the clamp using even pressure on all the clamping screws (finger tight only).

4.2 "O" rings on port fittings & Clamping Ports



The "O" rings seal the port closures against the top plate so no microbes can get in or out. If their effectiveness is compromised, the fermenter is functionally useless.

The port closure "O" rings are located in grooves in the closure and can be easily levered out for exchange. Remember to lightly grease the new "O" ring.

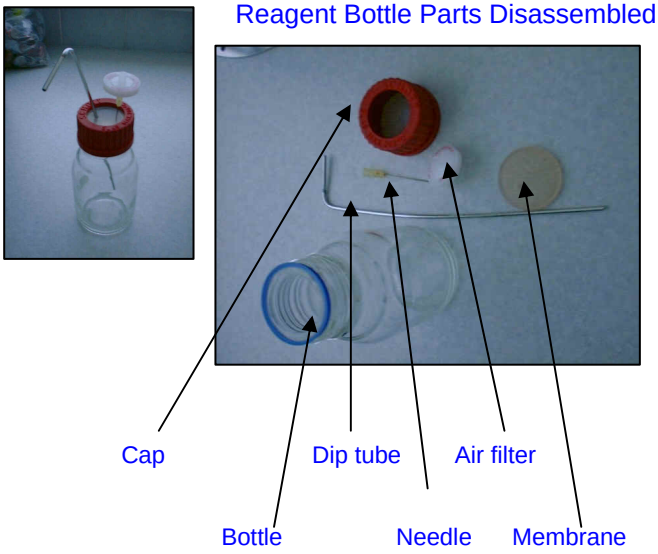


Port fittings which have pipes going through them (e.g. sampling devIce, antifoam probe), use a clamping arrangement to secure the pipe in addition to the "O" ring which actually seals against the top plate. In this case, there will usually be a small cylinder of silicone tubing inside the fitting which may become deformed and sticky over time. This should be replaced at the same time.

The antifoam electrode has an insulating sheath that fits over the length of the probe, except for the tip. This is like a transparent plastic coating which can become ripped in time.
Replacement involves removal of the old covering and applying the new cover using the same heat shrink method employed for electrical cable sheathing with a strong blower or a flame.

4.3 Membranes, filters, Reagent Bottle Fittings & Sampling Device.

These additional items are usually replaced by the user as necessary. However, as part of routine maintenance, it makes sense to check any fittings in these perpiheral items (eg. dip tubes) for corrosion and to replace clearly worn or damaged membranes and fittings.



4.4 Mechanical Seal

This is another compnent of vital importance for maintaining a contamination-free culture. It prevents microbes from entering (or leaving) via the rotating drive shaft. The mechanical seal is subject to wear over time and is normally replaced at annual service inspections if the customer requests this.

Any contamination of cultures which cannot be explained by the usual reaons of seed problems or "O" ring failure may be due to a fialure of the mechanical seal.

1. To exchange the mechanical seal the vessel top plate must first be removed by unscrewing the bolt holding the clamping ring in place and then lifting the top plate free.

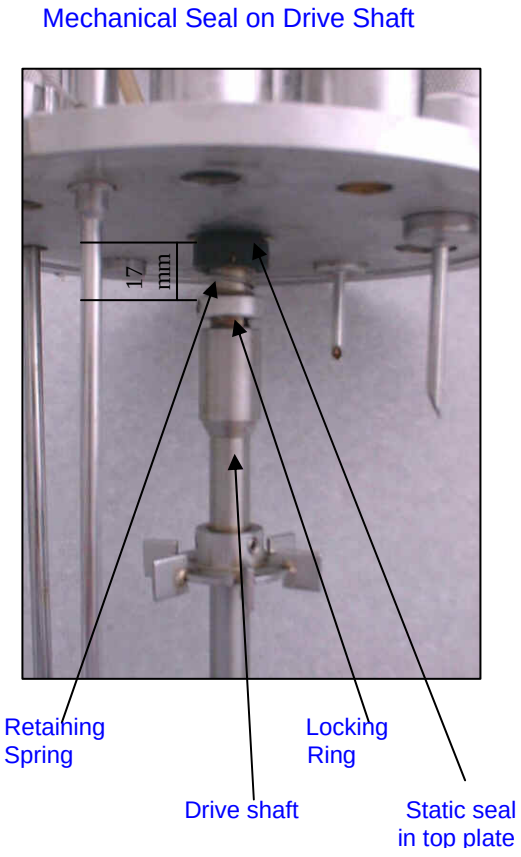
2. It is a good idea to remove the pH and dissolved oxygen electrodes first along with any other fittings which reduce access to the centre drive shaft.

3. Allow the top plate to rest on its side so the underside can be clearly seen. The mechanical seal is recessed into the drive shaft/bearings housing and is held in place by a spring and locking collar which are fitted to the bottom of the drive shaft.

4. Remove the lower section of the drive shaft (which has the impellors fitted) by using a spanner to loosen the shaft from the top end where there is a flattened section. Once loosened, this can be wound off the thread located at the top of the remaining part of the shaft which is normally
5. concealed by the body of the lower drive shaft.

6. A small Allen key is used to loosen the retaining ring grub screw which holds the tensioning spring onto the drive shaft and both can then be withdrawn by pulling firmly upwards so they come free.

7. The rotating metal part of the mechanical seal can now be removed by pulling upwards to expose the soft face of the static carbon slip ring. Any signs of scoring or "rings" on this face is a clear indicator of wear.



8. The static part of the seal can be lifted out by prizing it upwards from the recess which retains it. An O ring is located beneath the static seal, which must also be removed.

A new seal is fitted by reversing this procedure

WARNING
Do not touch either "face" of the static or rotating parts of the mechanical seal as this can damage them.

The new seal is packed "assembled" but there are covers over the matching faces of the static and rotating seals which must be removed when they are ready to be fitted.

9. The O ring is firstly greased lightly with eg. high vacuum grease, and placed into the recess of the drive shaft/bearing housing by carefully sliding it over the end of the drive shaft.

10. The cover is removed from the soft static seal and it is pushed over the drive shaft and located snugly into the O ring. The seal is shaped for this with a "step" which fits into the O ring. The seal is handled by its SIDES ONLY during this operation.

11. The metal rotating seal is now pushed into place so the polished faces meet securely. A small O ring and washer which are inside this part of the seal may come loose during fitting and must be pushed back into place firmly.

12. The top of the rotating seal has a slot in it into which a corresponding lug on the tensioning spring is fitted by pushing the spring (the right way around) onto the shaft until the lug firmly locates.

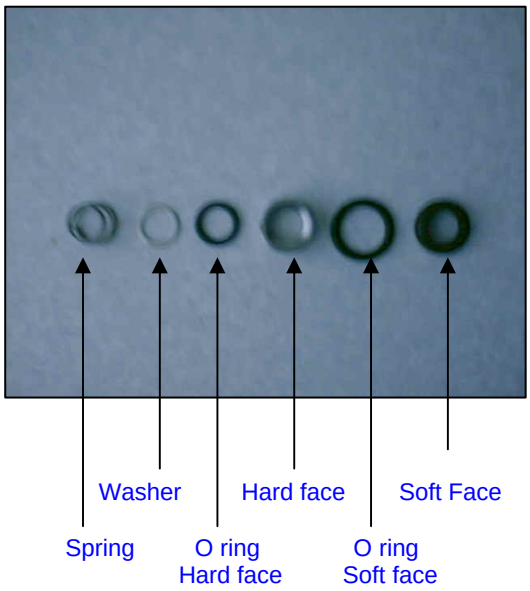
13. The retaining ring can be slipped over the drive shaft and pushed down firmly to hold the spring in place.

14.. Pushing down firmly on the retaining collar, compress the spring until the gap between the flat base of the top plate and the bottom edge of the retaining ring is 17mm (see diagram).

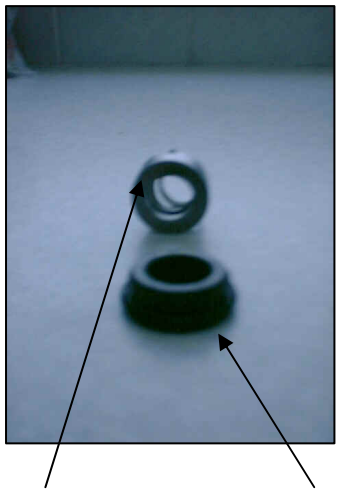
15. Still holding the tension on the spring, tighten the retaining collar grub screw with an allen key until it is secure. The lower section of the drive shaft can now be screwed back and tightened.

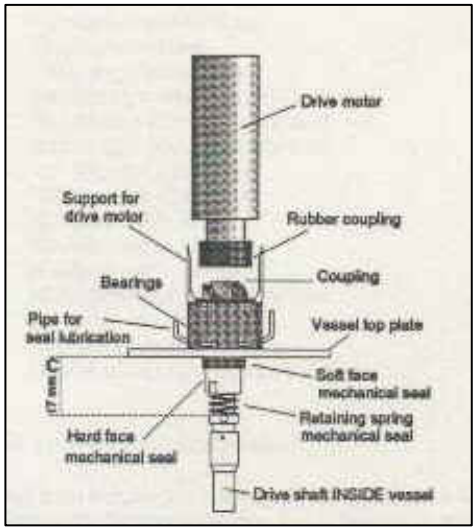
WARNIING
The lower section of the drive shaft can be removed for exchange or cleaning but the retaining ring should never be loosened unless you intend to replace the mechanical seal. This may dislodge the seal face and cause scoring.

Mechanical Seal Component Parts



Seal Faces Assembled





4.5 Battery on Memory Card

The memory card stores information about setpoints, calibration, PID setup, profiles and other preferences. A "watch" batttery preserves tha data on the card even when the Labfors is switched off. After a period of 1-2 years the battery loses power and the user reports a loss of settings every time the unit is switched off.

A further reason for wishing to remove the battery may be that a "PIN number" password has been set and the user has forgotten it. Removing the battery clears the memory.

The user will normally exchange the batttery themselves but may well ask for it to be done as part of preventive maintenance.

1. Remove the card from the slot in the Labfors main pcb housing (noting the orientation of the card).

2. A small screw is found on the back edge of the card. Remove this with the special tool provided with the card or using a watchamaker's screwdriver.

3. Put your fingernail or eg. a thin penknife blade into the small crack above the area containing the screw hole and pull backwards.

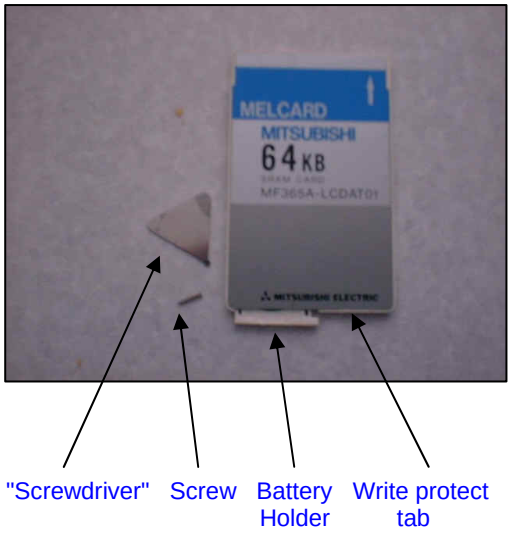
4. A battery holder is revealed with the battery sitting in position. Note the orientation of the battery and exchange for a new one. TYPE: xxxxxxx

5. Ensure the write protect tab on the back edge of the card is seet towards the middle of the card in the "Write" position before replacing it in the Labfors.

The card will be "initialised" by the Labfors on first switching the fermenter on and all setpoint values set to zero with defaults for all other data.

If the customer has downloaded the current configuration to a PC, the data can be restored to the card using Option 6 in the Main Menu "Copy Memory Card".

Memory Card



"Screwdriver" Screw Battery Holder Write protect tab

5. Trouble-shooting the Labfors

5.1 Basic Operation

Problem	Possible Causes	Remedy
Labfors does not work at all **(No green mains power light)**	Power lead not plugged in or Mains power not turned ON Fuses blown Break in power connections	Plug in - switch mains ON Check plug fuse (10A+) Check fuse in base unit (10A) Check plug connections Test mains cable continuity Check connections at mains socket in base unit Check reset in plug socket
Mains power, but no display	Unit switched ON but not touched for longer than 30 minutes No 24V supply. *Can the red LED indicating 24V supply be seen in the LED display in the third section of the Labfors?* If NO No Back light. *Can figures be seen dimly in the LCD display?* If YES No 24V supply to pcb. Main pcb or back light faulty. *If 24V supply to main pcb OK, can peristaltic pumps be operated manually?* If YES If NO	Touch any key. LCD screen should now light. Check power supply to 24V feed from transformer. Replace transformer if necessary. Replace back light Check 24V feed to main pcb Replace screen panel Replace main pcb
LCD Screen halts at P.O.S.T. Screen (Power On Self Test) **Screen shows random characters and /or "odd" behaviour of pumps etc.** **System "hangs" or does not respond to inputs**	No Memory card. *Do all tests show pass and the display asks for memory card to be inserted?* If YES Processor Problem Memory card problem	Memory card should be inserted. *N.B. Never insert or remove a memory card if the unit is switched on* Switch On and OFF to clear fault. If no change, remove & replace processor or exchange it for a new one. Re-initialise card/remove battery briefly to clear mem.
Keys fail to work	Processor problem or fault with keypad	Switch On and Off. If no change replace keypad or processor (try processor first)

For general, random faults with operation, pumps etc. check earthing & "labdrive" pcb.
If setpoint, calibration etc. data is not being retained, exchange memory card battery.

5.2 Drive System

Problem	Possible Causes	Remedy
Motor does not start	Speed controller OFF. *Is the speed control switched ON at "Start Fermenter" or "Fermenter Options" screens?*	Switch ON.
	PO2 control switched on and set to work with stirrer	Switch pO2 Control by Stirrer OFF to test operation
	Stirrer setpoint=0	Check Stirrer set point >0 and deadband does not include zero rpm.
	Drive shaft not moving. *Can the drive shaft on the vessel top plate be turned by hand?* If NO	Remove obstruction or replace bearings on drive shaft
	No power to motor. *Is power being supplied to motor pcb?*	Replace speed control pcb or motor
	No power getting to motor from speed control pcb	Check connections.
Drive motor runs slowly or erratically (pulses or "hunts")	Speed control malfunction. *Does speed match displayed value for speed? (visual estimation)* If NO	Check connections to speed controller pcb
		Check position of DIP switches and potentiometers on speed control pcb are set correctly
	Motor bearings failure.	Check motor bearings by rotating motor shaft by hand
		If PO2 control by stirrer is switched ON, turn it OFF
	Tachometer fault	Remove top from motor and visually check tachometer segments for signs of damage
	Check DIP switches are correctly set	

5.3 Temperature System

Problem	Possible Causes	Remedy
No display or incorrect display of temperature	Faulty Pt-100 sensor	Check connections *Test calibration with eg. ice and hot water*
	Faulty amplifier module	Replace amplifier module Check connections
	Processor problem	Replace Pt-100 and re-test Switch OFF and ON again. Replace processor
No temperature control	Control not active	Ensure control is turned ON
	Control output not given - *Check indicator LED's, is the heater light ON?* If NO	Check connections Replace Labdrive pcb in 3rd section
	Processor Fault *Check "Fermenter Overview" does this show heater/cooling valve active?* If NO	Check connections Replace processor or main pcb
No heating or inadequate heating	*Set a high setpoint eg 45^{o}C, Can you hear the circulation pump working?* If NO No Water	Turn water supply ON
	Faulty Circulation pump (if fitted) If YES *Does the vessel get hot?* If NO Over-temp. cut out fault	Check connections Replace circulation pump Check operation
	Faulty heating element	Check connections Replace heater
	Faulty "Aqua" pcb	Check power output to heater Replace pcb
	Neg factor too high - *control biased towards cooling*	Adjust
No cooling or inadequate cooling	No Water or inadequate flow	Turn cooling water ON
	Set a low setpoint eg 5^{o}C, Can you hear the circulation pump working? If NO Faulty Circulation pump (if fitted) If YES *Does the vessel get hot?* If NO Faulty cooling valve	Check connections Replace circulation pump Check connections Replace cooling valve
	Incorrect Neg. Factor	Adjust *eg. if cooling water temperature is too high.*
Temperature drifts up or down over time	PID settings incorrect	Adjust (esp. P term) - *default values available*

5.4 pH System

Problem	Possible Causes	Remedy
No display or incorrect display of pH	Faulty pH electrode	Check connections *Test calibration with pH 4 and ph7 buffers* *Check slope of electrode for signs of ageing* Replace or regenerate electrode
	Temp compensation OFF	Turn this to ON in normal use
	Faulty amplifier module	Check connections *Replace sensor or use simulator to test* Replace amplifier module
	Processor problem	Switch OFF and ON again. Replace processor
No pH Control	Control not active	Ensure control is turned ON
	Pumps not set to Auto	Check and set to Auto if necessary (*pumps submenu)*
	No control in dead band	Ensure this is OFF or small value
	No reagents	Ensure bottles full, line open & connected to vessel
	Pumps not operating properly	Check operation manually and prime pumps.
	If pump heads do not rotate Faulty pump motor	Check connections Check drive belt Replace pump motor
	Wrong tubing type	Check tubing type (not too hard) **and spring tension**
	Faulty Solenoid *Is only one pump effected?* If YES	Check connections to solenoid Replace solenoid
	Control output not given - *Adjust set points. Check indicator LED's, do the acid and base pumps lights ON?* If NO	Check connections Replace Labdrive pcb in 3rd section (*also for pump mal-functions)*
	Processor Fault *Check "Fermenter Overview" does this show acid/alkali pumps active?* If NO	Check connections Replace processor or pcb
pH drifts up or down over time or acid & alkali added almost continuously in turn	PID settings incorrect	Adjust (esp. P term) - *default values available*
	Incorrect strength of reagents	Check reagents ~0.1-1.0M

5.5 Dissolved oxygen system

Problem	Possible Causes	Remedy
No display or incorrect display of dissolved oxygen	Faulty pO2 electrode	Check connections *Test calibration with zeroing gel and max. speed + air flow* *Use simulator if available* *Check slope of electrode for signs of ageing* Replace membrane or whole electrode
	Faulty amplifier module	Check connections *Replace sensor or use simulator to test* Replace amplifier module
	Processor problem	Switch OFF and ON again. Replace processor
No dissolved oxygen control	Control not active	Switch control ON
	Actuator not switched to ON	In "Po2 Def" screen, select stirrer, flow and/or gas mix as appropriate. Other settings must be made for flow and gas mix to work. *(only control by stirrer is available as standard, factory default is for flow control to be set ON, so this must be changed)*
	No gas flow into vessel	Check for bubbles in culture Check service supply
	Fault with Actuator	
	a) Stirrer Motor	Check as in 5.2 Replace if necessary
	b) Mass flow control valve	Check connections Replace if necessary
	c) Gas Mix unit	Check connections Check services supply of gas Check solenoid valve operation *(listen for activation, does valve get warm over time, test for flow with air)* Replace valve if necessary
Dissolved oxygen drifts up or down over time or stirrer "hunts"	PID settings incorrect	Adjust (esp. P term) - *default values available* Full 3-term control is often needed for good pO2 control

5.6 Antifoam & Feed Pump

Problem	Possible Causes	Remedy
Foam not sensed	Faulty Antifoam electrode *Check lead & amplifier by shorting cables together, does display show "AF ON" and/or pump operates* If YES If NO Processor fault	 Check connections Replace antifoam probe Replace amplifier module Check connections Replace
Foam always/frequently detected	Antifoam probe sheathing damaged Pump switched to ON Processor fault	Replace sheathing Switch pump to Auto Check connections Replace
Antifoam control does not work	Control not active Pumps not set to Auto No reagent (or inadequate) Pump not operating properly *If pump heads do not rotate* Faulty pump motor Wrong tubing type Faulty Solenoid *Is only one pump effected?* If YES Control output not given - *short out probe.. Check indicator LED's, does the antifoam pump lights ON?* If NO Processor Fault *Check "Fermenter Overview" does this show antifoam pump active?* If NO	Ensure control is turned ON Check and set to Auto if necessary (*pumps submenu)* Ensure bottles full, right reagent & connected. Line open to vessel. Check operation manually and prime pump. Check connections Check drive belt Replace pump motor Check tubing type (not too hard) and spring tension Check connections to solenoid Replace solenoid Check connections Replace Labdrive pcb in 3rd section (*also for pump mal-functions)* Check connections Replace processor or pcb
Feed Pump does not work (see above for range of possible pump faults)	Pump not switched to ON No set value given	Switch pump ON Give cycle & set times (secs)

5.7 IRIS Software Connections to Labfors (assumes prior correct installation by Infors)

Problem	Possible Causes	Remedy
No Data-logging or control	Cable not connected	Connect firmly at both ends
	Cable connected to wrong COM port	Check which COM port a fermenter is assigned to and swop if needed.
	Cable connected to wrong fermenter	Swop cable if necessary.
	Cable not earthed at one end	Ensure earth strap connected at the computer end to a case screw
	Fermenter not switched to remote operation	Select this option at the *Fermenter* instrumentation.
	COM port settings incorrect Fermenter mis-assigned	Check in Peripherals dialogue box (Extras, menu, devices sub-menu).
	Device model incorrect eg. set for ISF not S-DDC	Check in Fermenter Properties dialogue box.
	Wrong protocol for comms. Eg. baud rate or parity mis-set.	Click on Settings button in Peripherals dialogue box and check settings re. fermenter manual.
	Conflict with other devices on COM port eg. a mouse	Ensure the fermenter COM port is not shared - check Control Panel settings in Windows
Error opening com port Message-box appears	COM port settings incorrect	Check in Peripherals dialogue box (Extras, menu, devices sub-menu)
	COM port not existing on this computer	Try different com-port
	Conflict with other devices on COM port eg. a mouse	Ensure the fermenter COM port is not shared - check Control Panel settings in Windows
Logging but no Control	Parameter not set for this	Click remote operation ON in the Edit Measured Parameter dialogue.
	Fermenter settings are not correct	Set accept remote on the fermenter control panel.
No change in logged value	Backup value may be ON - look in Text view table	Click backup value OFF in the Edit Measured Parameters dialogue

6. Repair Items

6.1 Testing of Process Parameters - setup, calibration actuators etc.

The Labfors can be thought of as a single container for measurement and control using at least 5 different operational sub-systems i.e. temperature, speed, pH, dissolved oxygen and foam. Additional functions can be added via peripheral items: *see Section 2 for explanations of standard functions.*

Part of fault diagnosis and repair requires that you have a knowledge of how each process parameter is controlled and setup for normal operation.

This requires familiarisation with the section of the operating manual dealing with the U-DDC instrumentation. A short quide is included in Chapter 2 for testing on installation but more detailed information is required for fault diagnosis.

If the Labfors does not function at all on switching ON, check the cable fuse, laboratory earth trips and main fuse on the machine by the power indicator light. A fuse is also present on the motor controller pcb (**p**rinted **c**ircuit **b**oard).

Testing each parameter should follow a common pattern:

1. Ensure relevant probe is in place - look for signs of damage or eg. no electrolyte or physical dents,
2. Ensure correct services are switched ON eg. water
3. Ensure the parameter has a realistic setpoint for the test eg. to check the cooling valve, the temperature setpoint may be set to 5°C.
4. Check that control in Dead Band (BD) is switched to ON &/or the actual value for Deadband is near zero eg. <0.5
5. Check calibration of parameter before starting fermenter.
6. Check PID values for irregularities eg. large I value or no P value.
7. Start fermenter and ensure the parameter is turned ON
8. If pumps or valves are involved, make sure these are switched to Auto or have realistic manual set valves.
9. Monitor the action of controllers via the "Fermenter Overview" screen and LED indicators in the third section:
10. Use your senses for additional verification of actuators working eg. if the heater works, the vessel will get hot or you may be able to hear solenoid valves "click" on or off.
11. Some parameters take a long time to get to fully-operational condition eg. dissolved oxygen electrode needs at least 2 hours with power supplied. Don't take the first value as correct, especially soon after autoclaving.
12. Look at measured values and the raw A/D converter readings on the calibration page - do they roughly match eg. pH7= approx. 512 - an A/D reading of 100 or 1000 would suggest a fault (see addendum for more info.)
13. Unexpected values or odd behaviour from measurement probes can sometimes indicate an earth problem which may not show up on a conventional electrical test (eg. the dissolved oxygen electrode is very sensitive to a poor earth connection, leading to the value drifting high).

Default values for calibration and settings are provided within the EPROM for re-initialised cards and new installations - see separate addendum UDDC installation information sheet.
The next stage in fault investigation usually requires you gain access to the relevant actuator for more direct tests:
CHECK COMPONENTS BY SWAPPING WITH THOSE IN ANOTHER UNIT OF THE SAME TYPE IF POSSIBLE.

pH and Dissolved Oxygen Simulator

Calibration is best achieved using a certified simulator for pH and dissolved oxygen as this tests both the cable and amplifier (a suitable unit is made by the Valley Instrument Co Inc. of Exton, PA. USA) If calibration is successful using the simulator, incorrect readings can then almost certainly be attributed to a faulty probe or earthing problem.

A simulator can be used for temperature also but it is often cheaper and easier to carry a spare Pt-100 sensor known to be calibrated properly (ice water and boiling water provide 2 certain reference points at normal altitudes and atmospheric pressures).

If you do not have access to a simulator, useful tests can still be performed on site.

LED INDIC-ATOR	RELATES TO THE ACTION OF:
	Motor
	Foam Pump
	Base Pump
	Acid Pump
	Circ. Pump
	Feed Pump
	Cooling Valve
	Heater
	Overtemp always ON
	24V Power always ON

Indicator LEDS in the 3rd section of the Labfors

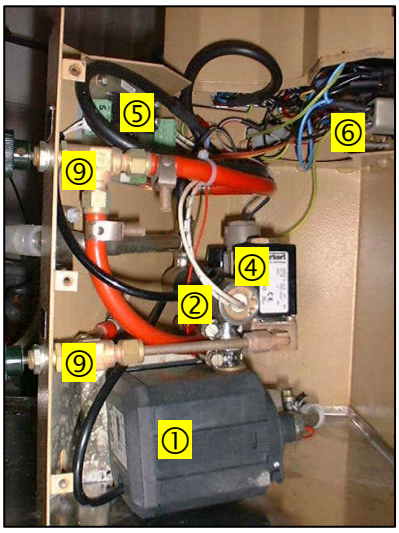
6.2 Removal of Covers -Main Sections of the Labfors

The base unit of all Labfors contains the following

Bottom Section:

Undo the 3 screws at each side to the rear of the panel and lift forward gently to gain access to:

1. Thermocirculator pump (if fitted)
2. Heater element in pocket (if fitted)
3. Cold water inlet pressure regulation valve
4. Cold water control valve (if fitted)
5. Heater pcb 20263 with cut out if no water present
6. Transformer connection block & mains socket
7. Water inlet pipe on left (if fitted) OR
8. Electrical connections to heater pad (if fitted)
9. Manual control valves for water inlet to vessel jacket (if fitted) and exit gas cooler

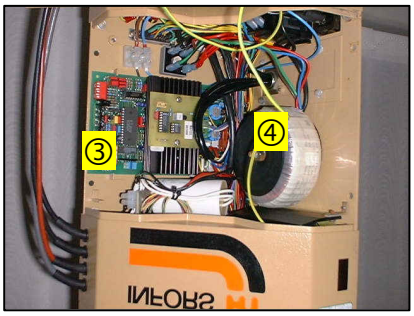


Bottom Section

Second Section:

Undo the 2 screws at each side to the rear of the panel and lift forward gently to gain access to:

1. Air pressure regulation valve
2. Rotameter fixing screws
3. Motor controller pcb with adjustment potentiometers
4. Mains transformer
5. Air inlet pipe on right of panel cover

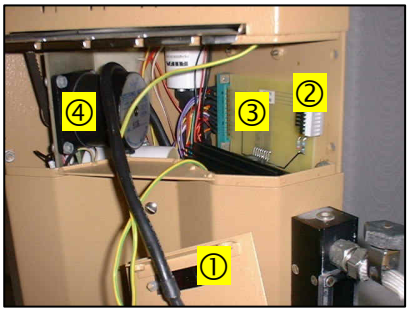


Second Section

Third Section:

Undo the 2 screws at each side to the rear of the panel and lift forward gently to gain access to:

1. Operational amplifier module & ribbon cable
2. Diagnostic LED's showing actuator operation
3. Digital controller pcb
4. Motor for peristaltic pumps & drive belt



Third Section

Top Section:

Undo the 3 screws on right side to the rear of the panel, 1 screw on the left rear plus an additional screw at the top rear.

Remove the screws on the top of each peristaltic pump.

Lift the panel forwards then upwards past the pumps to reveal:

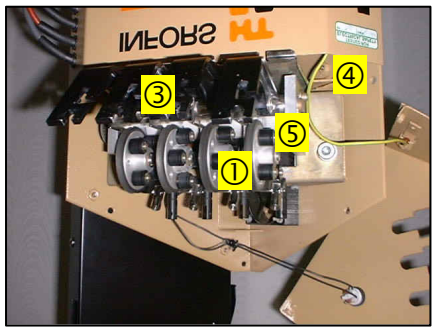
1. Peristaltic pump heads
2. Roller
3. Solenoid valves to pull pump heads onto roller
4. Switch for manually starting pump motor
5. Small instrument fan

Main pcb Housing, Screen and Keypad (Master only)

From the front side you can gain access to:

1. Memory card slot on "neck" at right
2. RS232 serial port for printer/computer connections on "neck" at left

The mains socket (main fuse), the hour counter, ID plate and motor connection cable are at the left rear of the base unit.



Top Section

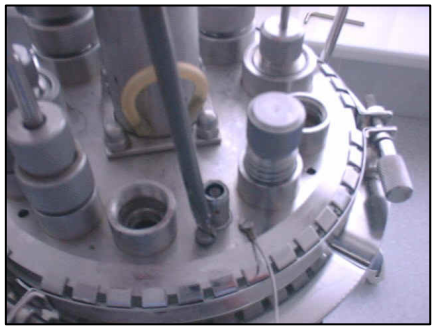
6.3 Exchange of Pt-100 Sensor

This is necessary when it is shown that an incorrect value is coming from the sensor. Use a second, calibrated probe in its place to confirm the fault is not with the cable or amplifier module.

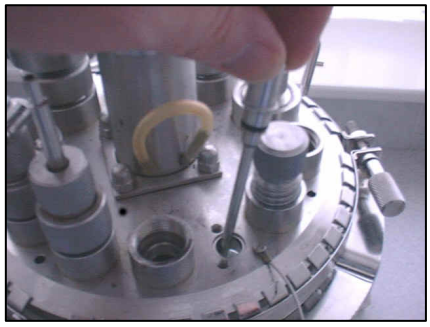
If you do not have a second probe, check the calibration values at 0oC eg. ice water and approximately 50^{o}C (hand hot is considered to be 56^{o}C). Of course, this only detects gross errors and not small inaccuracies.

If it can be shown the sensor is at fault, exchange is simple:

1. Locate Pt-100 sensor on top plate. From the top, a 2-pin Lemo connector can be seen in a 10mm diameter port.
2. Undo the two slot-head screws holding the sensor in the top plate.
3. Pull firmly upwards to release the sensor from the port
4. Lightly grease the "O" ring on the replacement sensor with a little high vacuum grease.
5. Replace the electrode firmly into the top plate port and screw down into place.
6. Connect to the operational amplifier unit and check readings.



Remove Screws



Withdraw Pt-100

6.4. Exchange of the Circulation Pump (if fitted).

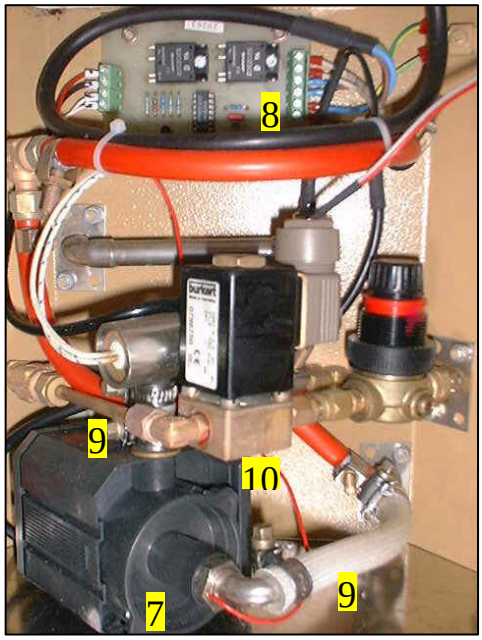
N.B. For systems with a heater pad, the Aqua print connects directly to a socket on the left side of the base panel.

The circulation pump provides heated water to the double jacket of the vessel for temperature control of the culture. The pump switches on as soon as the temperature controller is turned on and can be heard when in operation. Any air in the system (which causes the noise) is usually displaced quite quickly.

If the pump cannot be heard operating and the culture temperature alters very little, this is an indication that the pump has failed. Also, the pump may have to be exchanged (or at least repaired) if it begins to leak.

Disassembly:

1. Remove the screws supporting the bottom section of the base unit (3 at the rear left, 3 rear right).
2. Gently lift the bottom section forward and outwards a short way
3. Remove the earth leads
4. Reach inside and remove the small ribbon cable coming from the base unit onto the middle of the "Aqua" pcb (part no20263).
5. The front section can now be turned clear of the main body of the base unit to allow easy access.
6. Locate the pump at the bottom of the section (part 12325)
7. Unsolder the red wire linked to the right angled tubing at the front edge of the pump.
8. Disconnect the three wires supplying power to the pump from the terminal bock on the lower, right hand edge of the "Aqua" pcb. Note the arrangement of the wires.
9. Disconnect from the water supply at each end of the pump by unscrewing the "Jubilee clips" holding it to the braided silicone tubing used for these connections.
10. Release the pump from its supporting backplate by unscrewing the retaining screws.



Exchanging Circulation Pump

11. Remove the end fittings from the faulty pumps and re-fit them on the new pump.
12. Check the braided silicone tubing for signs of wear and replace if necessary (part no 10454)
13. Re-assembly is the reverse of this procedure

6.5 Exchange of Heating element

The indication of a need for exchange will be

1. No heating (maybe a dead short on the element also - check using a multi-meter)
2. Water circulates
3. The controller output indicates heating is called for
4. There is power entering and leaving the connections on the "Aqua pcb" to the heater (white & white striped cables)

To exchange the heating element:

1. Remove the screws supporting the bottom section of the base unit (3 at the rear left, 3 rear right).
2. Gently lift the bottom section forward and outwards a short way
3. Remove the earth leads
4. Reach inside and remove the small ribbon cable coming from the base unit onto the middle of the "Aqua" pcb (part no20263).
5. The front section can now be turned clear of the main body of the base unit to allow easy access.
6. Locate the heater cartridge (part no 13719)
7. Remove the two wires from the heater element to the Aqua pcb (white and white-striped fabric), noting the arrangement of the wires.
8. Remove the circlip (part 11597) holding the heater cartridge from its sheath using a pair of circlip pliers
9. Withdraw the faulty heater element.
10. Grease the "O" ring (12969) on the new heater element and place into the sheath.
11. Connect wiring to Aqua pcb.

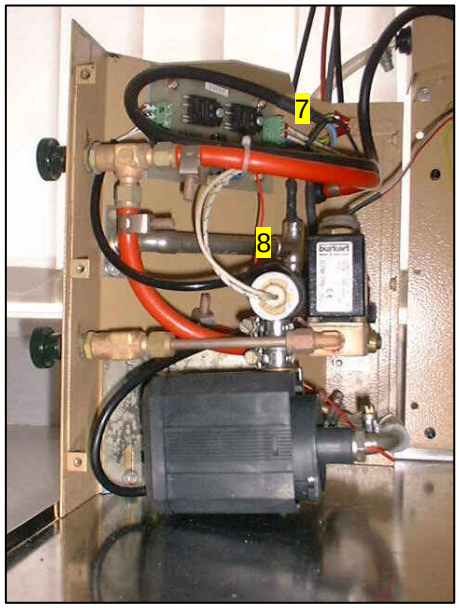
6.6 replacement of the "Aqua" small heater pcb

This part would need to be exchanged if power was not being supplied to either the circulation pump or the heater.

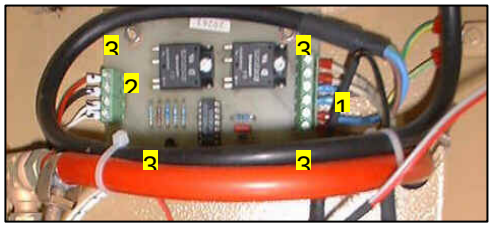
1. Remove wiring from the right-hand side of the terminal block from the heater element, pump and feed from the base unit. Note the arrangement of the wires.
2. Remove wiring from the left side of the terminal block from the various over-temperature devices.
3. The Aqua pcb is held to the front casing by 4 nuts - undo these to free the pcb for replacement.

Other small electrical components can be exchanged:

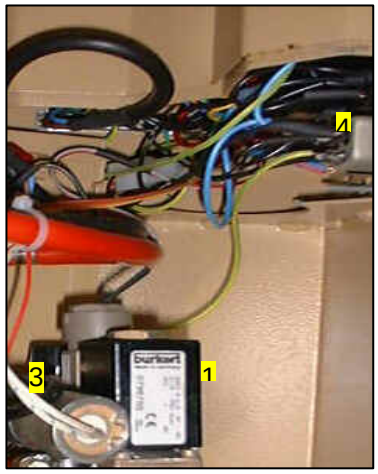
1. The 2-way magnetic cooling valve (19948)
2. Temperature switch for 90oC cut-out, braided (12271)
3. Temperature switch 80oC complete (21989)
4. Mains power inlet socket and filter(14499)
5. Fuse 10A (12292)
6. Mains ON light and green cover (12250/19162)
7. Operational hour counter (12573)



Heating element & Wiring



Replacing "Aqua" pcb



Other Components in bottom Section

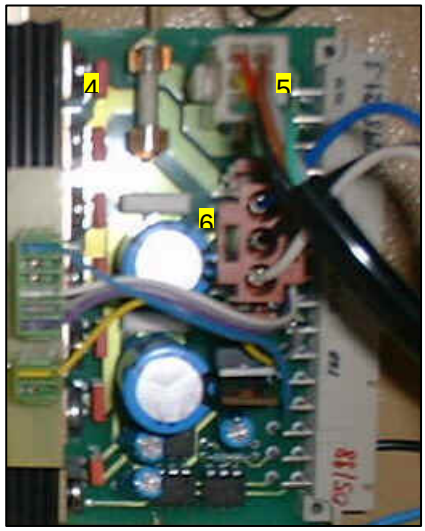
6.7 Exchange of the Drive Motor

The most usual form of Labfors motor is the current round-bodied unit. It is connected to the base unit via an armoured cable terminating on the right side above the mains switch.

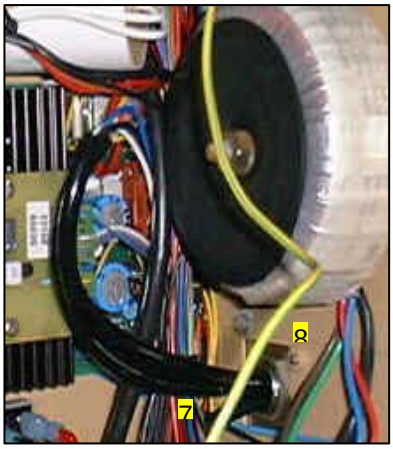
The motor may need replacing due to physical damage, no feedback from the internal tacho-generator (in the top unit). bearings failure or the coil windings burning out.

The motor is controlled by a speed controller pcb which is mounted in the second section of the base unit. Connections to the motor are all made using plug-in connectors.

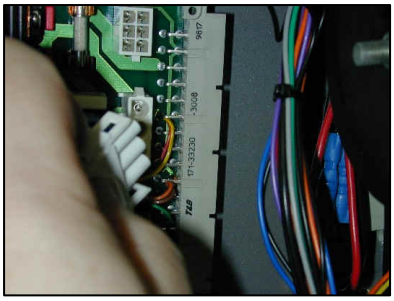
1. Unfasten slot head screws holding second section of drive system in place (2 x rear left, 2x rear right)
2. Carefully remove front section holding the gas pressure regulator.
3. Remove the earth lead from the front section so it can be taken away.
4. Withdraw the speed control pcb (22169) by pulling it forward to reveal the connections to the motor at the rear of the speed pcb
5. Disconnect the large white connector at the top rear of the speed pcb
6. Disconnect the power connector on the centre-rear of the speed pcb
7. Disconnect the free-hanging terminal block with connections from the motor (black/red/yellow wires L-R). This is in the main bundle of wiring at the back of this section.
8. Undo the rectangular armoured cable connecting panel to the outside rear right side of the base unit (2 screws).
9. Pass the connectors out to free the motor and cabling.
10. Reverse stages 8-1 above to connect the new motor, which is supplied with the armoured cable and metal elbow already fitted.
11. Check new motor for speed control.
12. A green LED will light on the speed control pcb when the motor is above 250rpm.



Motor connections on speed control pcb



View of motor connections to outlet of armoured cable



Remove the connectors from the speed pcb - (5&6)

Remove plate holding the armoured cable connection (8)

Motor cables removed from base unit (9)

6.8 Exchange/adjustment of the speed control pcb.

The speed control circuitry consists of the main pcb (22169) which has a smaller pcb (22168) "piggybacked" onto it.

If the motor does not work at all, check the small fuse on the motor pcb first.

The small piggyback pcb is easily exchanged by unfastening the two connectors from the main speed control pcb and undoing the two screws holding the smaller pcb in place.

The main pcb is removed and replaced as follows:

1. Unfasten slot head screws holding second section of drive system in place (2 x rear left, 2x rear right)
2. Carefully remove front section holding the gas pressure regulator.
3. Remove the earth lead from the front section so it can be taken away.
4. Withdraw the speed control pcb (22169) by pulling it forward free it from the 96-way connector it links to at the back of the second section.
5. Disconnect the large white connector at the top rear of the speed pcb
6. Disconnect the brown power connector on the centre-rear of the speed pcb
7. The speed control pcb can now be pulled forwards and freed from the retaining brackets at the front of the section and replaced.

There are both dip -switches and potentiometers on the front edge of the pcb. These alter the characteristics and response of the motor controller.

The DIP switches should be in the following positions:

S 1	S 2	S 3	S 4	S 5	S 6	
■		■		■	■	OFF
	■		■			ON

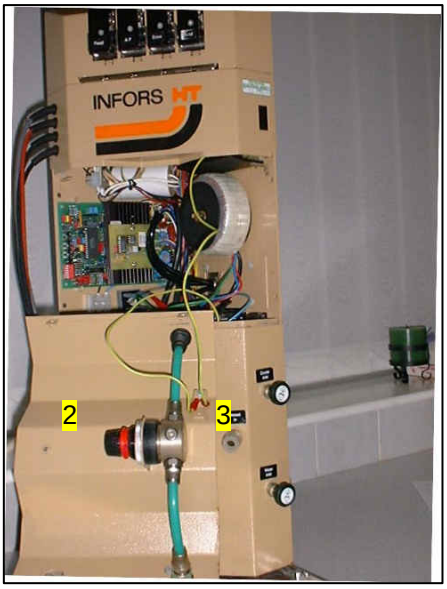
The three potentiometers are usually factory set and should only be adjusted on advice from Infors.

Their purpose is

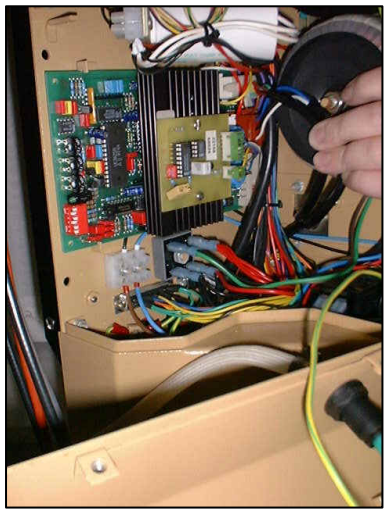
P1 Internal set-point value

P2 Peak power limit

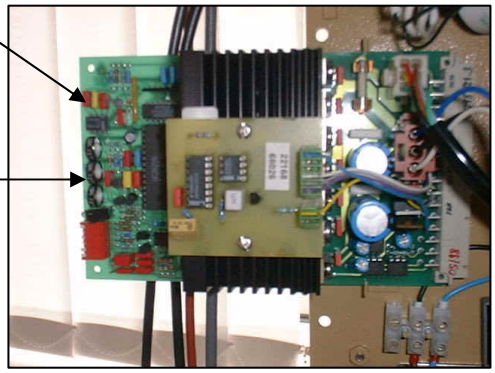
P3 Constant power limit



Cover removed from second section



Connections at the rear of the pcb



Location of dip switches and potentiometers - speed control card partially withdrawn

6.9 Exchanging the rotameter inner cylinder

This is a simple job, usually required if a user acquires a large eg. 13L vessel. The maximum airflow needed is 1.5 vessel volumes per minute. If this cannot be met by the original rotameter flow rate range, a new one must be installed.

Calibration tables are included for each rotameter type in the Labfors operating manual., The scale on the Vogtlin rotameters is calibrated in litres/hr as standard and the type is given by the code after the manufacturer's name eg. V100-80-14 is usual.
To exchange the inner cylinder (which is the actual variable area tube):

1. Remove the front, plastic cover (4 screws).
2. Unscrew the large screw on top using a hexagon key. The tube can be levered out gently from between the top and bottom of the casing.
3. Replace the tube with the new one and replace the cover.

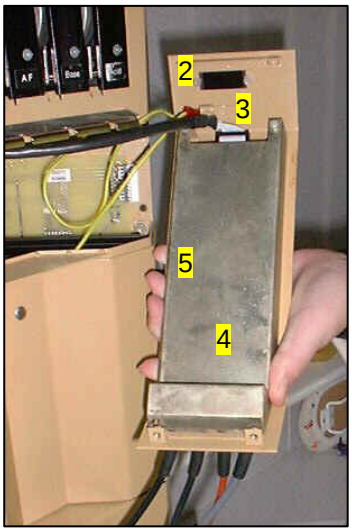
Rotameter

6.10 Exchange of the operational amplifier pcb

This is located in the third section and is connected to the front panel which comes away when the screws are removed.
The electrode cables terminate at the left side of the panel and link to the operational amplifier by a D connector. The purpose of the pcb is to digitise the analogue signals from the electrodes.
Exchange may be necessary if eg. a sensor value cannot be calibrated properly even with a simulator. Check the connections from the electrode cap and cable wiring before reaching this conclusion!

To exchange the pcb:

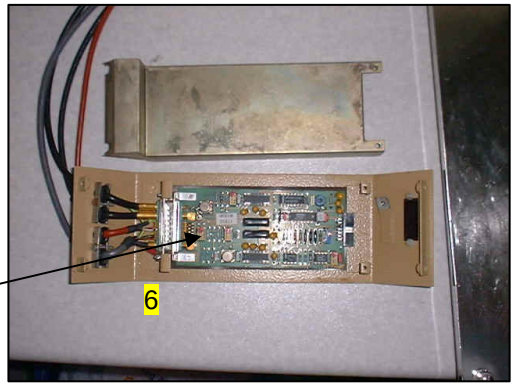
1. Remove the front cover by undoing four screws (2 left, 2 right).
2. Remove the earth lead from the front panel.
3. Remove the ribbon cable connector at the rear of the module
4. Rest the panel on its front to gain access to the amplifier module
5. Undo the two screws holding the metal protective shield and pull this backwards to expose the pcb (part 19939, plug in measuring unit).
6. Remove the pcb from the D connector where it links to the wiring from each of the four sensor cables.
7. Replace the pcb
8. When replacing the cover, lift the back edge slightly to allow the connector for the ribbon cable to pass through.
9. Replace the ribbon cable connector
10. Replace the pcb.



Measurement module with operational amplifiers pcb

To adjust antifoam sensitivity:

1. Remove the Op amp board
2. Remove the top cover
3. Remove the ribbon cable to free the cover then replace
4. At the front of the module, where the cables are connected, is a blue potentiometer marked 1-9
5. When there is no foam, the diode above should be lit
6. To reduce sensitivity, turn the potentiometer away from the 9 until the light goes out



Op. Amplifier pcb ready for exchange

For the foam sensor in the vessel, ensure the black wire is connected to the vessel top plate and the red wire is connected to the probe itself

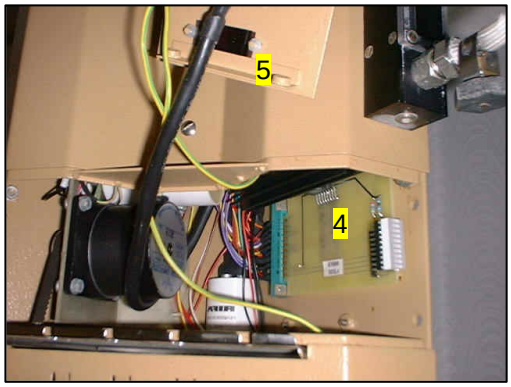
6.11 Exchange of the digital distribution pcb "Labdrive"

This pcb carries signals from the instrumentation to the actuators eg. heater, valve, pumps, etc. A set of indicator bars on the edge of the pcb shows when a particular actuator is supposed to be active.

If you do not see the correct light at the correct time. then suspect a problem with this pcb. Also, a number of seemingly unrelated problems such as pumps "chattering" or the stirrer speed not working properly can sometimes be ascribed to faults in the "Labdrive" pcb (part no. 20271).
Exchange is straightforward:

1. Remove the front cover by undoing four screws (2 left, 2 right).
2. Remove the earth lead from the front panel.
3. Remove the ribbon cable connector at the rear of the module and place the front section safely to one side
4. Remove the single screw holding the pcb at the front bottom where it passes through the heat sink.
5. Lift up slightly and pull forwards to release the pcb from the rear connector and its front support.
6. Replace the pcb and reverse the procedure for assembly.

When you have the pcb removed, it is possible to see the large capacitor at the very back of the third section.



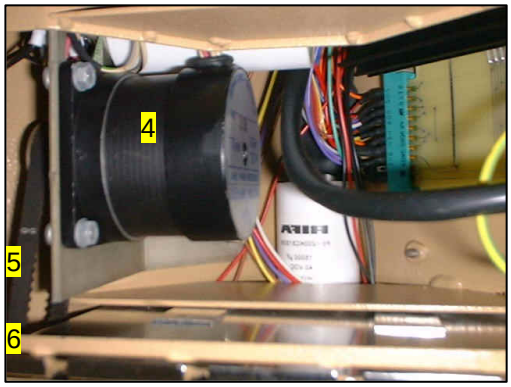
Third section "Labdrive" pcb

6.12 Exchange of peristaltic pump components.

The motor and drive belt for the peristaltic pumps can be accessed from the third section. The single stepper motor drives a roller which operates any (or all) of the four peristaltic pumps on demand. This is normally switched off unless pump action is called for or you press the manual button located behind the pump heads.

The top section houses the peristaltic pumps, the solenoid magnets which pull the pump heads onto the roller and the manual switch for pump priming.

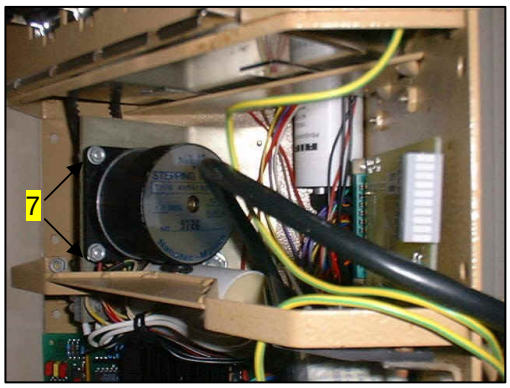
A small instrument fan (part No 12343) is also located in the top section.



Pump motor side on showing drive belt

a) Exchange of drive motor and belt:

1. Remove the front cover by undoing four screws (2 left, 2 right).
2. Remove the earth lead from the front panel.
3. Remove the ribbon cable connector at the rear of the module and place the front section safely to one side
4. The pump motor and drive belt can be seen mounted on an internal plate to the left of the housing interior. A large capacitor is also mounted on this plate below the motor.
5. The motor is held to the supporting plate by 4 nuts. Loosen these nuts to give enough play to remove the drive belt from the motor pulley and the roller above. Alternatively, free the drive belt by temporarily unscrewing the pump module and removing the drive belt from the roller pulley.
6. Disconnect the wires from the 8-way terminal block on the rear of the support plate, noting the arrangement of the wires.
7. Undo the nuts completely for removal of the pump motor.
8. A single large nut at the rear holds the support plate if removal in its entirety is required.
9. Re-assembly is the reverse of this procedure.

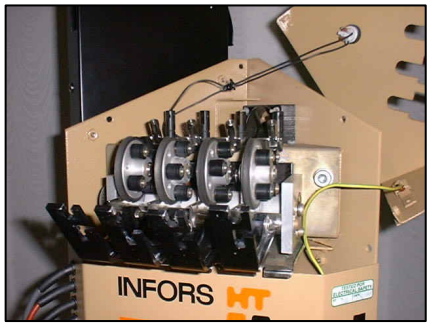


Pump motor face on showing retaining nuts

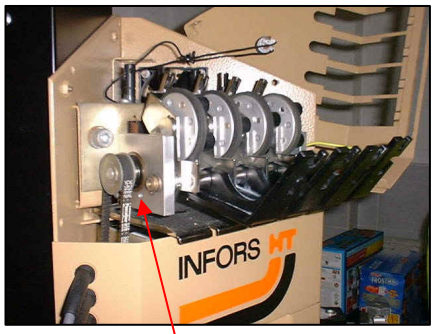
b) Exchange of pump heads, roller and solenoid magnets

1. Remove the front cover of the third section by undoing four screws (2 left, 2 right).
2. Remove the earth lead from the front panel of the third section.
3. Remove the ribbon cable connector at the rear of the module and place the front section safely to one side
4. The pump motor and drive belt can be seen mounted on an internal plate to the left of the housing interior. A large capacitor is also mounted on this plate below the motor
5. .Undo the 5 screws holding the top cover (1 back, 3 rear right and 1 rear left)
6. Remove the screws above each pump head and pull the black pressure plates forwards.
7. Lift the cover carefully upwards then rearwards to expose the pump system.
8. Disconnect the electrical wiring from the rear of the pump unit. The white connector block behind the pump magnets can be pulled apart to break most of the connections but a red and brown wire will still need to be cut to totally free the unit..
9. Undo the two large bolts (left and right) holding the whole pump module in place with a 6mm hexagon key.
10. Pull module forward and down slightly to remove the drive belt from the pulley on the left side of the roller.
11. The whole peristaltic pump module with solenoid magnets can now be placed on the bench for further disassembly

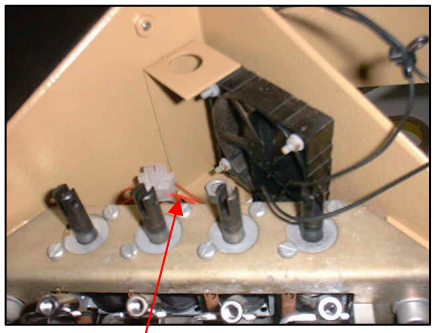
Removal of cover - 7



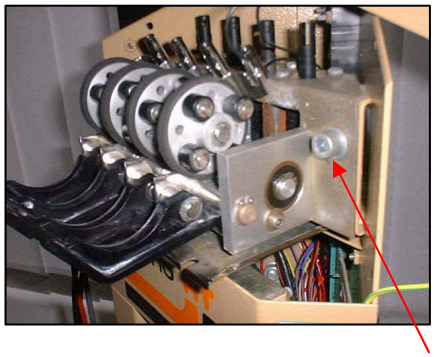
Peristaltic pump module



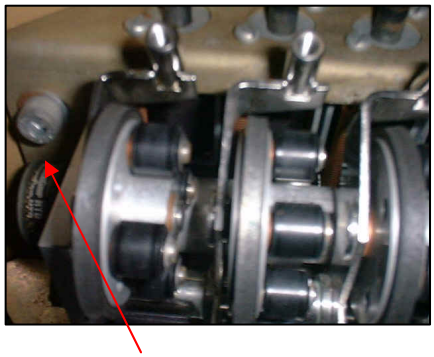
Side view showing drive belt -10



Magnet solenoids showing wiring behind - 8



Side view showing right retaining bolt -9



Close up showing left retaining bolt & roller -9

c) Dis-assembly of pump module after removal from Labfors casing.

N.B. Replacement of the main roller or pump heads should not be necessary unless they are physically damaged.

Important:
Replacement of the rubber bands around the edge of each pump head (to provide grip on the peristaltic tubing) does not require dis-assembly of the pump module for replacement. They can be pulled off the relevant pump head and replaced while the whole unit in place.

Separation of pump heads from the magnet solenoids.

1. Turn pump module so the pumps face away from you.
2. Remove the four screws (2 Left, 2 Right) holding the magnet solenoid housing to the pump head assembly.
3. Turn the unit around so the pump heads face you.
4. Remove the tensioning springs behind the pumps which link the pump heads to the solenoid magnets housing. A pair of long-nosed pliers are best for this. Only the top part of the spring needs to be removed to separate the two parts.
5. During re-assembly, ensure the plungers of the magnet solenoid are correctly re-located relative to the metal bars at the bottom of the pump head section. Correct operation depends on this.

Removal of a single magnet solenoid.
The magnet pull the pump heads towards the main roller after the drive motor has been activated.

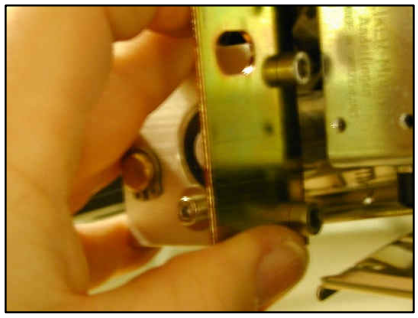
1. Undo the two cross-head screws holding the selected magnet in place.
2. Pull back the black insulation "blanket" at the rear of the magnet solenoid housing.
3. De-solder the two wires linked to the magnet.
4. Replace magnet and solder connections into place.

Removal of main roller
This part is rotated by the motor and provides the means for the peristaltic pump head to rotate when the relevant magnet solenoid pulls the pump head forward.

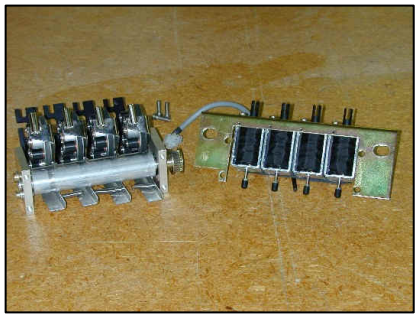
1. Undo the circlip holding the main roller in place.
2. Unscrew the retaining bolt using a hexagon key while holding the nut at the rear still with a spanner.
3. Remove the retaining bolt, nut and two washers.
4. Pull out the main roller from the left hand end (where the pulley is mounted).
5. Refit and re-assemble in the reverse order.

Dis-assembly of the pump head section.

1. Remove the circlip on the brass coloured rod which holds the pump assemblies in place.
2. Withdraw the rod (from the right side) to release individual pump head holders.
3. Remove the relevant pump head by taking away the retaining circlip.
4. Replace as necessary.
5. Reverse the procedure for re-assembly.

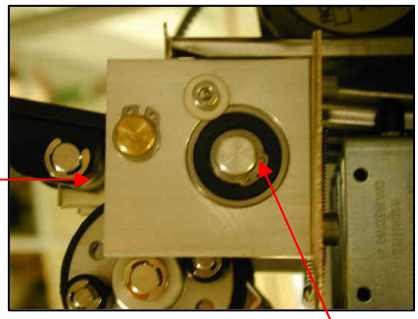


Removal of screws holding pump heads and magnets (2)

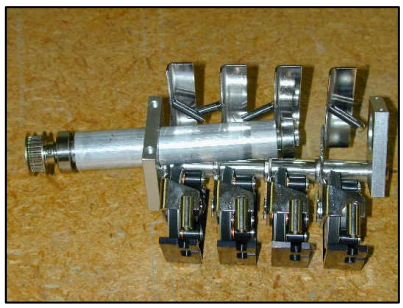


Pump heads and magnets separate

Wiring under insulation behind magnet



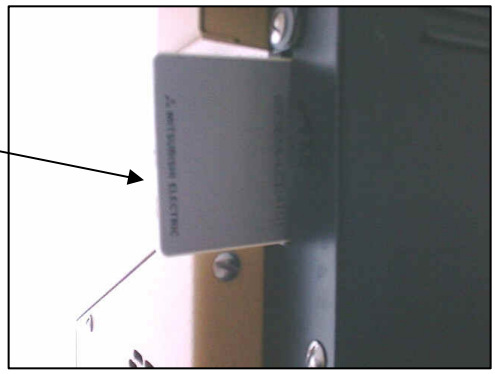
Right hand end showing main roller & bar for pump head supports



Main roller removed - bar holding pump head supports can be seen

6.13 Removal of Back Cover & Main pcb Modification/ Replacement of Master Units

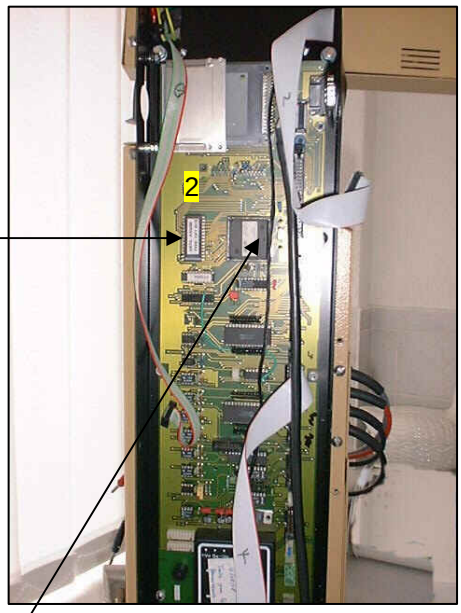
1. Turn the Labfors around for access to the large black panel at the rear of the Master unit.
2. Remove the memory card from slot on your left. The card is replaced with the text towards you (still looking at it from the back of the unit).
3. Remove the screws along the side edges of the panel (4 left, 4 right) using a flat-head screwdriver.
4. Lift out inner the cover and turn it gently to the left. You will see and earth lead at the bottom of the inside of the casing which needs removing with a cross head screwdriver.
5. You now have in-situ access to the main pcb. The EPROM and microprocessor can be upgraded from here without further disassembly.



Removal of memory card

Replacement of EPROM

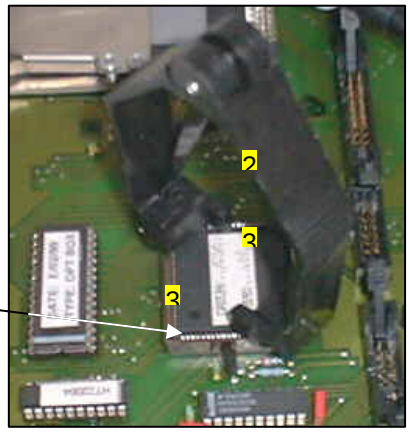
1. The EPROM gives the Labfors its "identity". It made need upgrading to eg. add an analogue box or other additional facilities.
2. The EPROM is located to the left of the large, square microprocessor chip located in the top third of the pcb.
3. Removal can be achieved using a chip extractor or by gentle leverage with a penknife blade or fine screwdriver - CARE.
4. Before placing the new EPROM in the empty socket check the pins are all properly aligned and, if not, gently press the side on the chip onto a hard surface to cause all the pins on that side to move inwards fractionally.
5. Locate the EPROM correctly by lining up the notch cut out of one end of the EPROM with a corresponding notch on the socket. Press firmly into place ensuring no pins are bent under during this process.



Location of EPROM & Processor

Replacement of the Microprocessor.

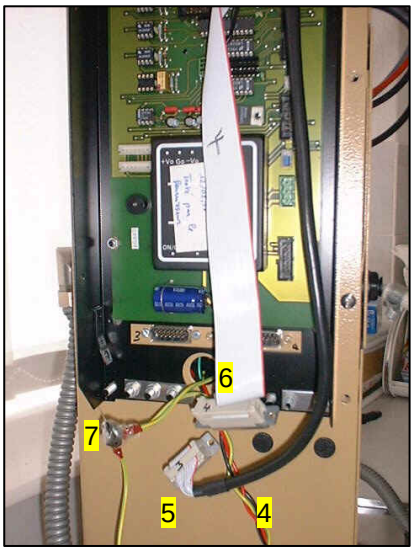
1. This is not normally necessary unless a fault condition exists. The microprocessor is easily located as it is a large, square, socketed chip in the top third of the pcb.
2. Removal must be made using the correct extraction tool (available from main electronics suppliers) which has two "claws" that locate into slots in the socket.
3. Note the position of two small circles on the chip (diagonally opposite) relative to these long slots in the socket so the new microprocessor can be correctly oriented.



Removal of Processor

Replacement of the main pcb

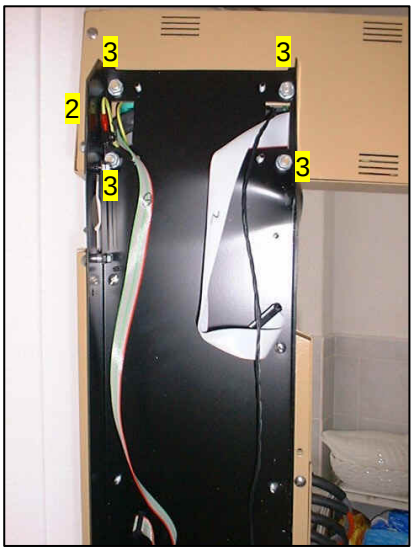
1. Remove back cover in the way described previously.
2. Remove the ribbon connectors and small black cable from the screen/keypad sections connecting to the main pcb.
3. Note the orientation of the red line on the ribbon cables and number both the cables and the sockets for easy re-location on the new pcb.
4. Remove the green 24V power connector coming from the bottom of the base unit to the main pcb.
5. Remove the serial link cable connected to the lower left of the base unit from the main pcb
6. Remove the analogue flat band cable connected to the lower right of the base unit from the main pcb.
7. Remove the earth lead connected at the lower left of the pcb.
8. Using a 7mm spanner, undo the six nuts holding the pcb to the rear of the black housing.
9. Remove the pcb (part no 21697) complete. Take care not to lose the small metal support spacers behind the pcb.
10. Replacement is the reverse of these steps



Replacing main pcb

Removal of pcb Housing with Screen/Keypad Unit

1. With the main pcb removed, disconnect the earth leads at the top left of the black housing.
2. Undo the four large screws holding the pcb housing in place - the housing plus screen/keypad come away as a single unit.
3. Remove metal plates on bottom edge of the pcb housing for replacing in new housing.

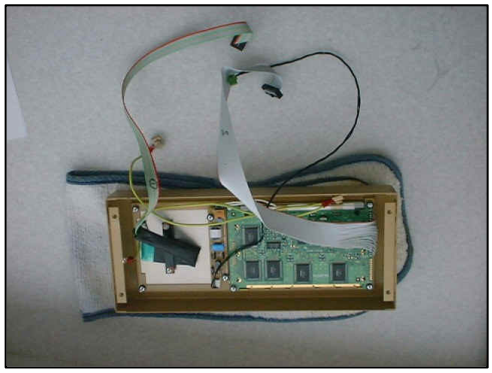


Main pcb removed -
removal of screen/keypad

Removal and Disassembly of Screen/Keypad

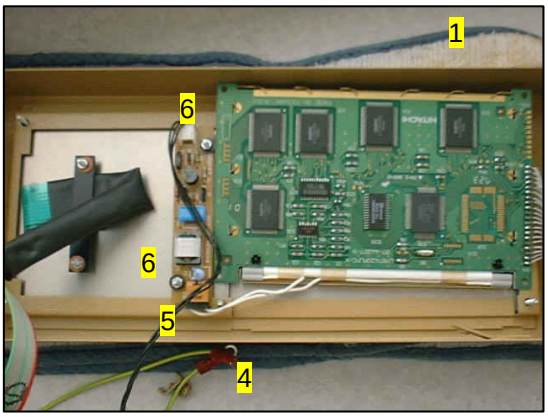
1. Place the screen/keypad unit on a soft cloth to prevent damage to the glass front.
2. Remove the inner guide for the memory card from the main pcb housing (2 x 7mm nuts).
3. Remove the four large nuts holding the back cover of the screen/keypad housing.
4. Bring cover up gently and remove the earth lead on the inside of the back cover.
5. Remove the back cover and the pcbs on the inside of the screen keypad can be seen.

*N.B. If removed **without** taking the rear pcb housing off, the front of the screen/keypad housing can be removed only by disconnecting all cables plus earth leads and undoing the 4 large nuts at the rear. The front of the screen/keypad housing can then be lifted clear from the front of the Labfors.*

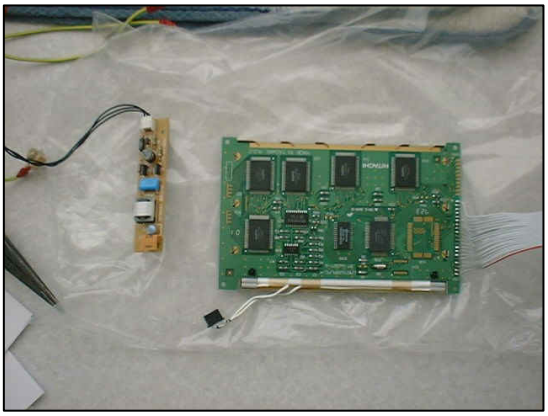

Screen & Keypad Interior

6.14 Replacing Screen and/or Keypad

1. Place glass screen face down on a cloth for protection.
2. Undo the 6 small nuts holding the LCD screen pcb on right.
3. Retain all spacers and ceramic washers.
4. Undo the earth lead at the bottom of the housing.
5. Disconnect small connector at the bottom of the keypad pcb which links two white leads from the LCD pcb to the small, perpendicular pcb across the keypad area.
6. Lift LCD panel and remove/replace as necessary.
7. Remove the small perpendicular pcb by undoing two small retaining nuts. The keypad area can now be removed if required.

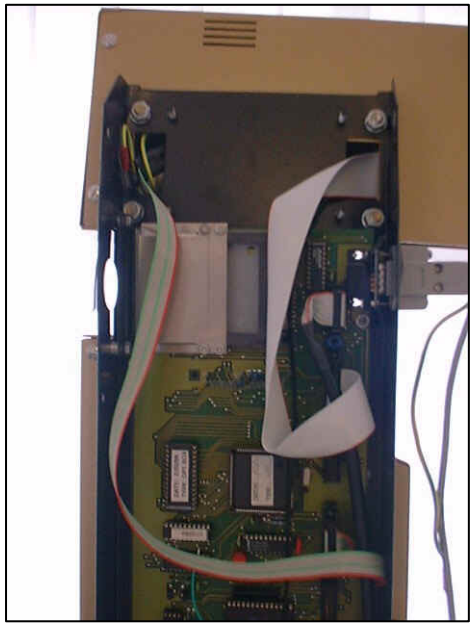


LCD Screen pcb


LCD Screen & Light/Buzzer pcb removed

Re-assembly

1. Fit the earth lead to the lower left hand side of the housing
2. Put the 4 small spacers into place and replace the screen pcb.
3. Re-fit the perpendicular pcb and re-connect the white wires from the screen.
4. Fit and tighten the retaining nuts to hold the screen pcb into place.
5. Reconnect the earth lead to the inside of the back cover plate of the screen/keypad housing.
6. Pass cables though the holes in the back cover of the housing ready for reconnection to the main pcb.
7. Replace the nuts holding the back cover.
8. Re-fit the screen/keypad to the main pcb (if this has been removed)
9. Reconnect the earth lead at the top right of the main pcb housing.
10. Replace the inner guide for the memory card.
11. Reconnect all cables
12. Refit rear cover.


Screen/Keypad re-connected

7.1 Fitting an Analogue Box

The Analogue Box allows additional input and output signals to be added to a Labfors Master unit. It replaces satellite fermenter number 4.

The box has connections at the front and rear:

Front:

From left hand edge (looking at the front), only the first three blocks of connectors are used on a basic analogue box (remainder are for chart recorder outputs).

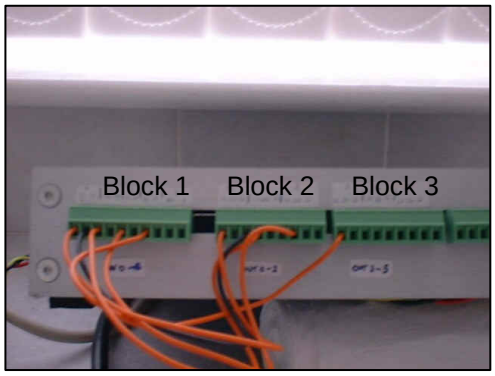
Block 1 - Inputs 0-4 (i.e. 5 analogue inputs 0-10V) arranged in groups of two

Block 2 - Outputs 0-2 (i.e. 3 analogue outputs 0-10V or 4-20ma) arrranged in groups of 3

Block 3 - Outputs 3-5 (i.e. 3 more analogue outputs 0-10V or 4-20ma) arranged in groups of 3

On the input block, the left hand screw is for connecting the signal line and the right hand for the signal ground.

On the output blocks, the left hand screw is for connecting the 0-10V output, the middle for 4-20mA output and the right hand screw for signal ground.



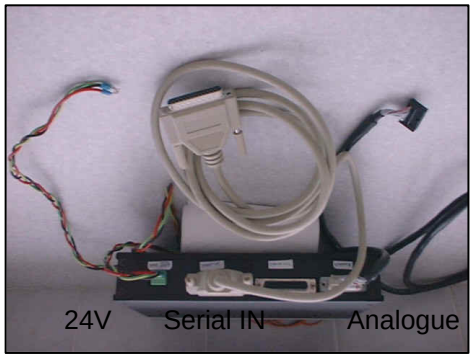
Analogue Box Front terminal Block

Back:

From the left hand edge, looking from the rear

24V connections - these are "piggybacked" onto the equivalent connectors on the main pcb

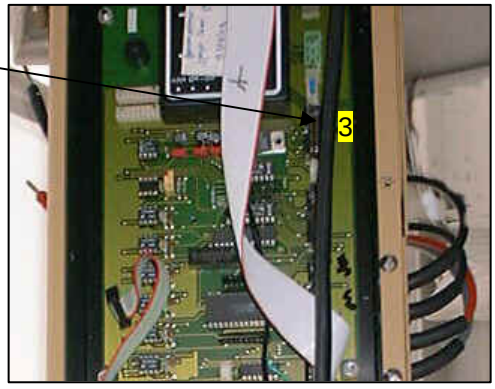
Serial IN - goes to base 25-D connection on the Master unit
Serial OUT - not used unless linked to satellite units.
Analogue I/O - linked to position 4 on main pcb



Analogue Box - rear view

Fitting:

1. Remove cover on main pcb housing at rear of Labfors
2. Connect 24V power leads to 24V connector on main pcb.
3. Connect analogue cable to position 4 on main pcb (count from top)
4. Connect serial link to 25-way D connector on base unit of the Master Labfors
5. Fit special EPROM for operation with analogue box
6. Replace cover and pass cables etc. through the semi-circular slots cut into bottom edge of the main pcb housing.
7. Use terminal block on front of box to connect the signal and ground lines of any peripheral equipment eg. input from a turbidity meter.
8. Connect any output signals from the box to the relevant peripheral eg. an analogue peristaltic pump.



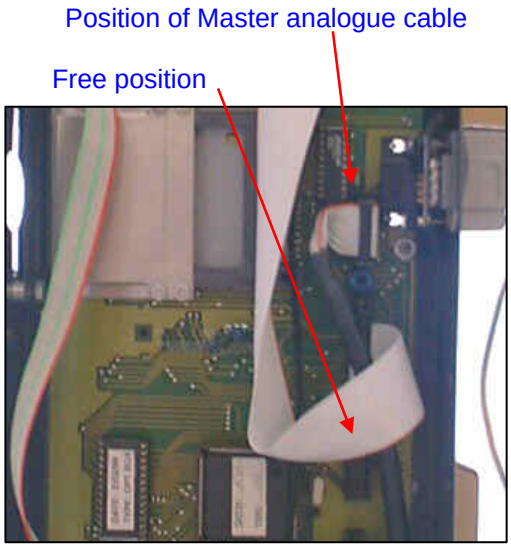
Analogue cable connection

Set-up display/calibration on screen (see operating manual)!

7.2 Fitting a Satellite unit to a Labfors Master

This upgrade is fairly quick and easy. The satellite unit has a base unit and a vessel but no instrumentation. It has an independent power supply. Up to two additional satellite units can be added to the Labfors Master unit, even if an analogue box is already fitted.

1. Set up the satellite unit close (within 3 metres maximum) of the Master unit.
2. Turn off the Master unit and ensure the satellite also is not powered.
3. Turn the Labfors Master unit around for access to the large black panel at the rear of the Master unit.
4. Remove the memory card from slot on your left. The card is replaced with the text towards you (still looking at it from the back of the unit).
5. Remove the screws along the side edges of the panel (4 left, 4 right) using a flat-head screwdriver.
6. Lift out inner the cover and turn it gently to the left. You will see and earth lead at the bottom of the inside of the casing which needs removing with a cross head screwdriver.
7. The small flat band cable from the Analogue D socket at the rear of the satellite unit is placed in either socket 2 or 3 which is on the upper right side of the main pcb. For location, an analogue box (if fitted) is always in position 4 and the equivalent cable from the master base unit will be in position 1.
8. Replace the rear cover, allowing the new cable to come out from the bottom of the instrument housing.
9. Replace the memory card the correct way around.
10. Connect the larger serial cable from the "Serial Out" 25-way D connector of the satellite unit to the 25-way D connector "Serial IN" on the Master unit.
11. Set the instrumentation to allow display of multiple fermenters (see operating manual)



Analogue cable connection

"Serial IN" connection on Master base unit

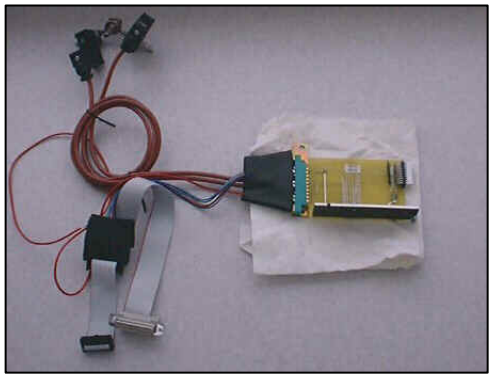
7.3 Connecting a 3+1 gas mix system with Mass Flow Valve

SECTION TO BE ADDED AT THIS POINT

Rear view of gas mix unit showing mass flow control valve

7.4 Fitting a 2-Gas Mix System

This provides an alternative control of pH and dissolved oxygen, especially for supplementation and animal cell fermentations.

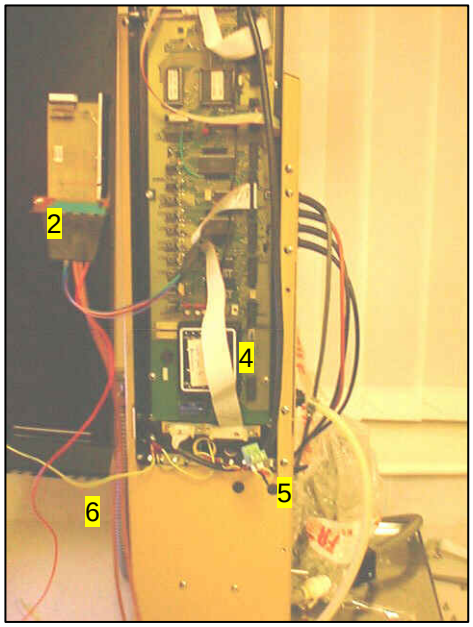


2-Gas Mix Kit

A kit is supplied containing:
- A pcb holder with mounting for fitting to the inside of the main pcb housing's cover. The screw needed for this is located on a black metal plate which is NOT used in this configuration.
- A small pcb with indicator panel with the unused side plate.
- Linked to the pcb holder is a connector which splits into a flat band cable with end 2 connections (25-way D and 20-way) using a middle joining connector plus the leads connected to the gas valves (marked O_2 and CO_2), which are electrically operated).
-A small strip of insulating foam

Installation:

1. Remove the back cover of the main pcb housing and drill a 4.5mm diameter hole in the cover- 290mm from the bottom and 82mm from the left hand edge (looking from the rear of the fermenter).
2. Fit the bracket on the pcb holder itself (brass coloured), using the screw and nut from the black plate, to the main pcb cover using the hole just drilled. If correct, the pcb etc. will just fit into the cover.
3. Remove the main flat band cable from the main pcb (25-way D connector to 20 way connector on pcb)
4. Replace with the new cable by offering the rear cover up to the main pcb.
5. Connect the single red wire to the corresponding red wire on the 24V connector on the main pcb (to provide power).
6. Pass the brown cable to the valves out from the main pcb using the cut-outs on the bottom edge of the housing. And carefully replace the cover (do NOT force it).



Gas Mix pcb fitted

Fitting of the valves

1. Remove the lead/connector from the two gas valves by undoing the small cross head screw at the top of each valve (retain rubber gaskets beneath the connector). The mid section of each valve can also be removed to aid fitting (undo the 2 small screws holding this section to the valve base).
2. Undo the outlet pipe at the top of the rotameter.
3. Undo the middle panel holding the rotameter and pull it gently forward to get access to the rear of the rotameter
4. Remove the two screws holding the rotameter in place and bring it forward
5. Screw the new fitting holding the two valves carefully into place (do NOT use the delicate arms of the valves themselves) . Refit the rotameter and replace the cover
6. Turn on the Labfors and set the unit for operation with the gas valves (Display Mix ON, Gas Mix ON, Gas Mix AUTO, Mix Offset0.001, Negative factor 0 in PID setup for pO2 - see diagram). N.B. the value of last setpoint will "latch" even if controller turned off. CO2 valve works in parallel with Acid pump (this MUST be set to Auto).

Gas valves fitted to rotameter

7.5 Linking to IRIS Software - Troubleshooting, Connection & Set-up

IRIS NT software provides data-logging, graphical display, archiving and supervisory set point control (SSPC) for Infors fermenters.

The software must be installed on a PC running Microsoft Windows 9x or NT4/2000. The link to the Labfors is made via an RS232 serial cable which connects directly to a port on the main pcb.

Control of the type of output and communications protocol is handled by special settings available in the **"Printer/Comms"** menu option of the U-DDC instrumentation. Use of the Labfors with a printer can also be controlled from here.

Details of installation of the IRIS software and operation with the Labfors is given in the operating manual for IRIS NT. This section deals with the very basic physical set-up and simple troubleshooting for an installed system you may find already connected.

Troubleshooting for an installed system:

See chart in Section 5.8

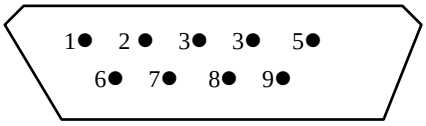
Connection (to a PC or a printer):

RS 232
On the side of the unit, a male, 9-pin connector is provided.

Pin Configuration

Pin 2 receive data (RD)
Pin 3 send data (TD)
Pin 5 Signal ground

Serial cable connections



Description	Computer Side 25 pins	Computer Side 9 pins	SDDC pins
Ground	7	5	5
Tx/Rx	3	2	3
Rx/Tx	2	3	2

No other connections are used by the LABFORS. For a functional data connection, the cable must match this schematic. A cable (9 Pin female - 9 Pin female) is available from INFORS.
Should your serial connection be to a 25-pin socket, a standard 9-25 pin adaptor can be used to allow a direct connection.
It is possible to make your cable connections according to the table and schematic shown. **Note!** With 9-pin to 9-pin connecting plugs, the data lines 2 and 3 must be crossed.

If a printer is to be connected, this must be via a SERIAL connection or a serial to parallel converter must be used.
It needs no additional settings to be made. Also, when a terminal programme is used, it is not necessary to issue a command for data to be transmitted.

Setup:

1. Connect one end of the serial cable to the Labfors Master
2. Connect the other end to the 9-pin serial port of the PC (Com1 or Com 2)
3. Connect the earth lead at one end to a good earth point eg. a casing screw.
4. Refer to IRIS manual for operation from this point.